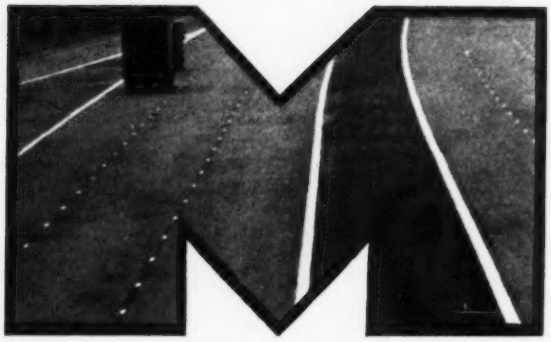
AUTOMOBILE ENGINEER

DESIGN · PRODUCTION · MATERIALS

Vol. 50 No. 11 NOVEMBER 1960 PRICE: 3s. 6d.

Dualloys

MAIN and BIG END BEARINGS



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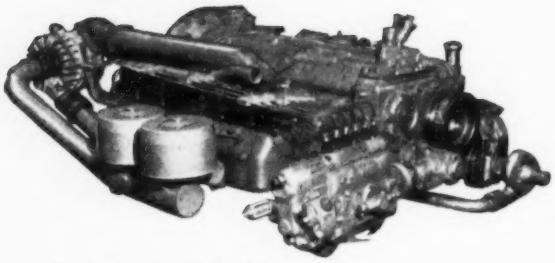
Performance Figures



The turbo-charged "CM5" Midland Red engine.

DUALLOYS BEARINGS FOR ALL INTERNAL COMBUSTION APPLICATIONS to every specification. Dualloys thin wall bearings can now be supplied as original equipment. Dualloys thick wall white metal lined, and copper-lead and lead-bronze lined bearings are already being used as original equipment on many petrol and diesel engined public service and road transport vehicles. Our capacity is planned to enable us to handle economically both large and small production requirements.

CHOSEN FOR THE M1. DUALLOYS Main and Big End Bearings are fitted *exclusively* not only to the engines of the famous Midland Red "Motorway Express" Coaches, which *average* 60 mph (top speed 85 mph) on the M1, but to *all* Midland Red engines now being built.

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DUALLOYS UNIQUE CASTING PROCESS prevents all lead segregation and copper hardening.

STRICT METALLURGICAL CONTROL and Laboratory supervision ensure the highest standards of accuracy and workmanship for all DUALLOYS Main and Big End Bearings.

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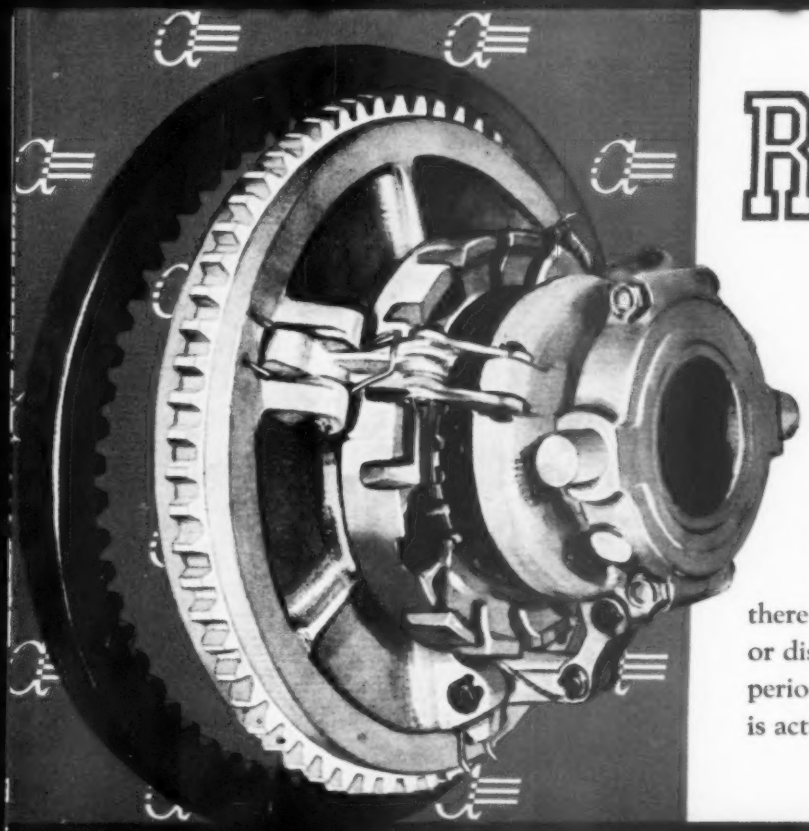

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OVER-CENTRE CLUTCHES AND POWER TAKE-OFF UNITS

Available in a wide range, from 5½″ to 16″ in single and multi-plate form. All Rockford clutches have the advantage that there is no running thrust either when engaged or disengaged, but only during the momentary periods when engagement or disengagement is actually taking place.

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THE BORG & BECK RANGE

includes strap-drive clutches in 12″, 13″, 14″ and 15″ sizes, heavy duty 16″ and 18″ lug drive clutches, all being available in single or multi-plate form, and 10″ and 11″ integral clutch and power take-off units.

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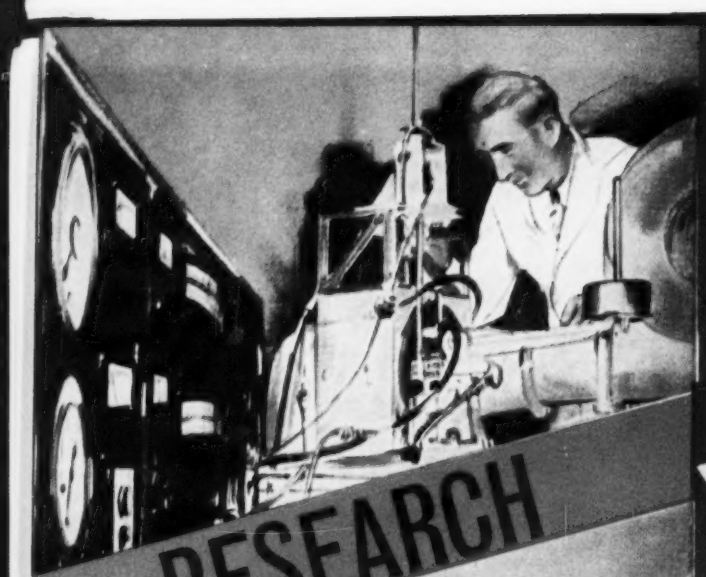

RESEARCH

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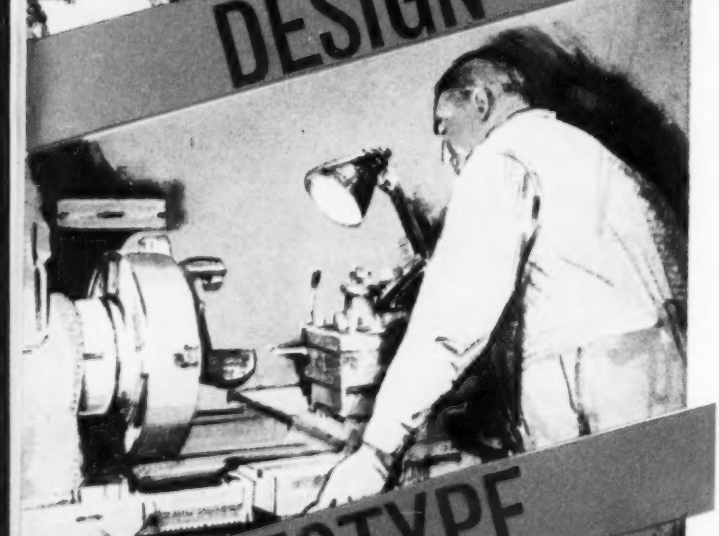

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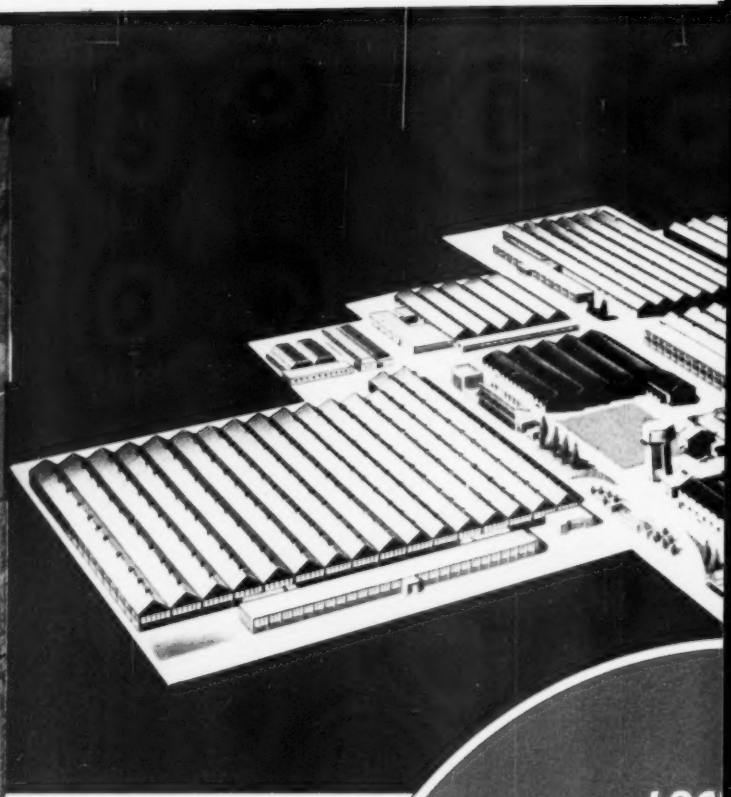

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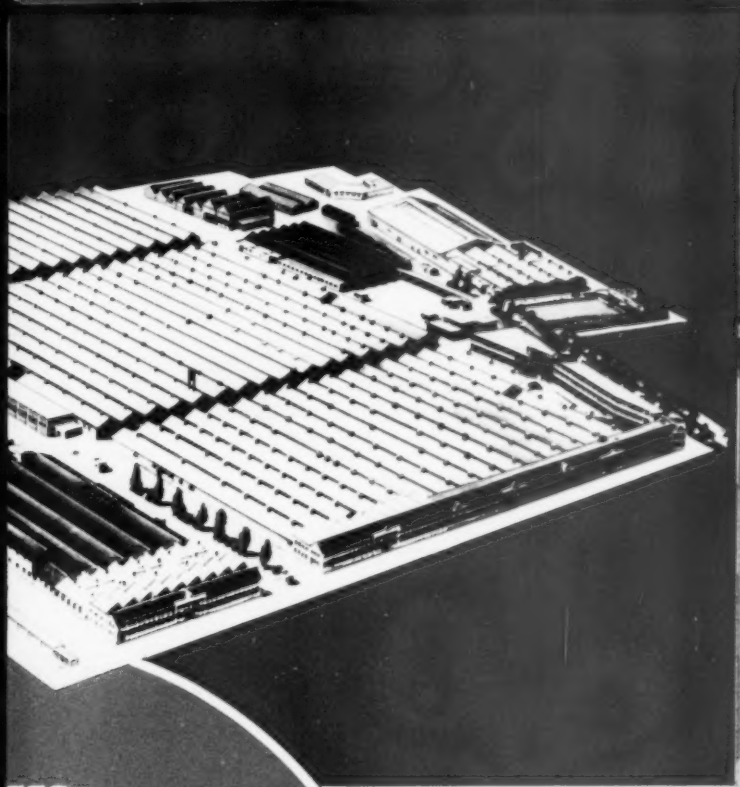

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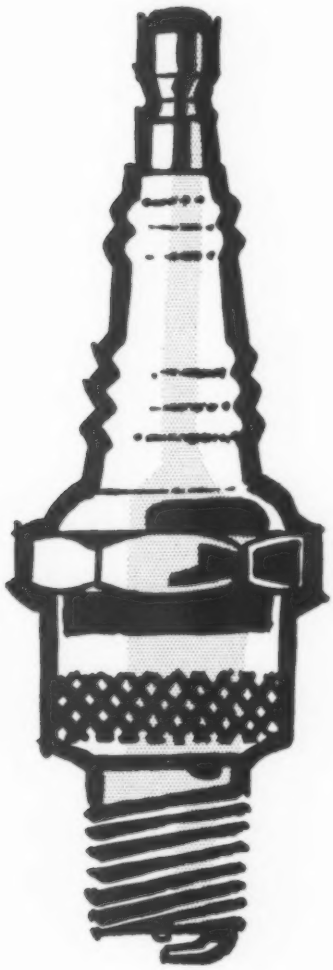

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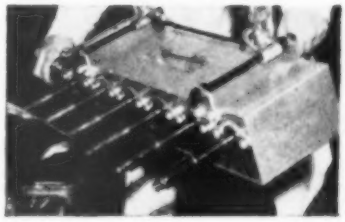

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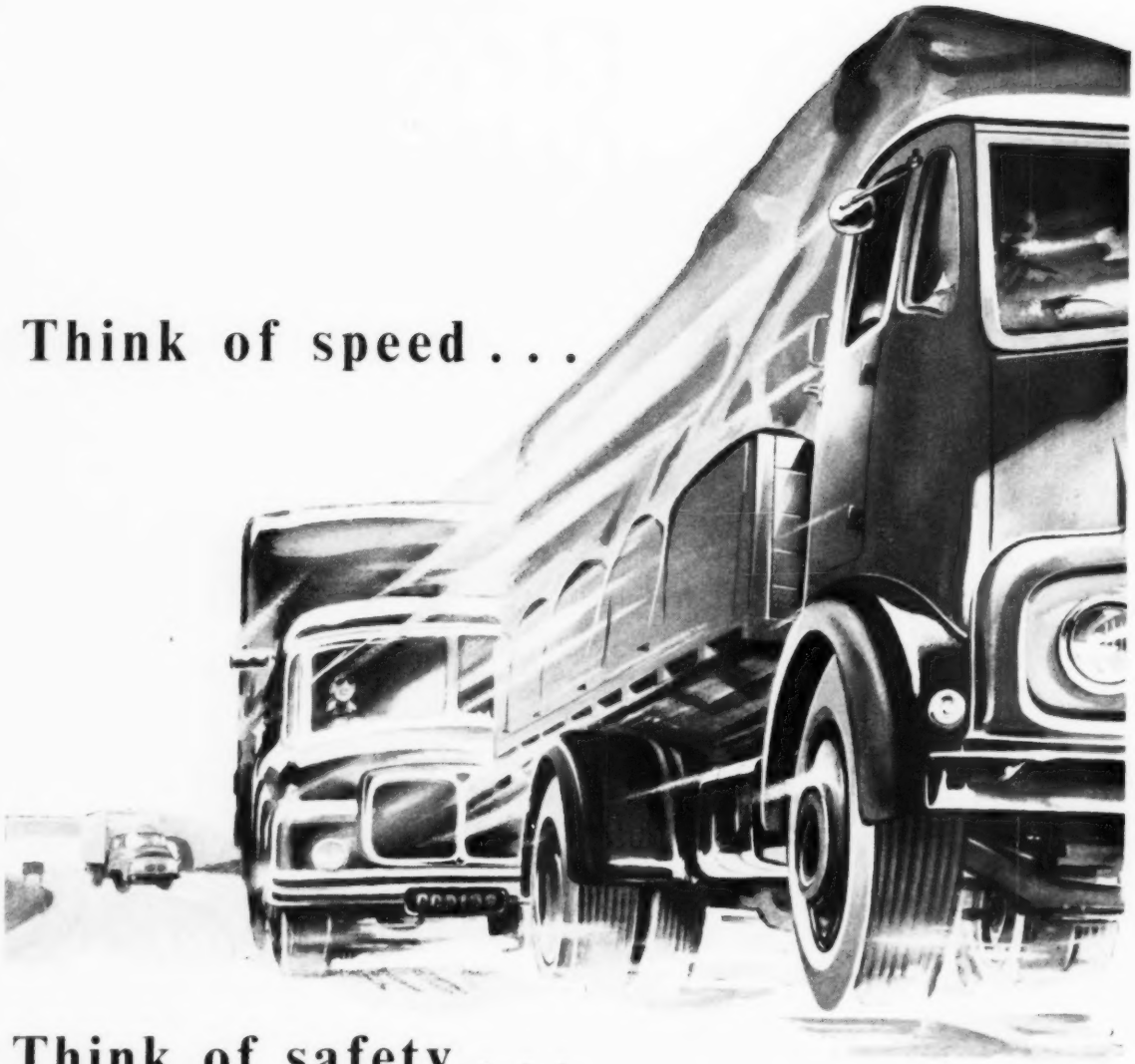

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There is an element of risk in the use of all man's contrivances, but it is usually quite insignificant. That is because we have come to rely on the components used; to take for granted that they will never fail us.

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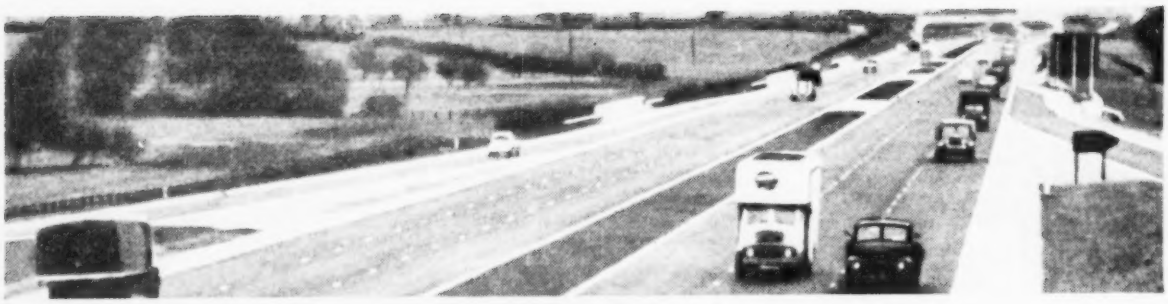
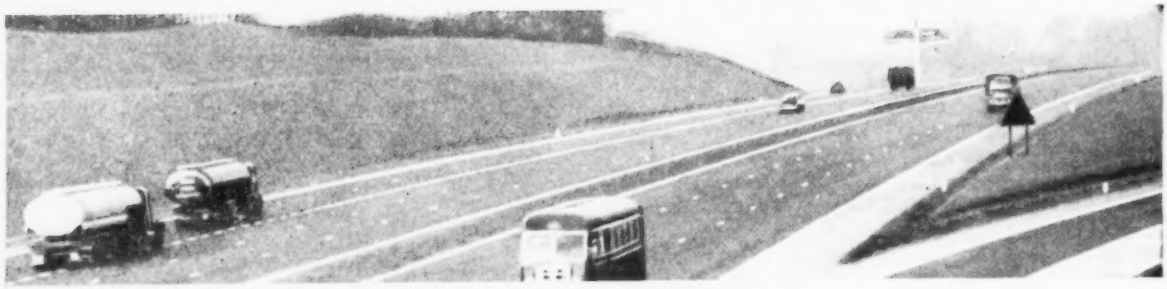


HIGH SPEED

AND HEAVY MILEAGE



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PROOF OF AL-FIN'S SUCCESS

Stuart J. Barr, director of Wallace Arnold Tours, writes:

"For some time now we have been replacing all pistons in our fleet with your Al-Fin Bonded type, as our vehicles become due for overhaul.

"The excellent performance of these bi-metallic pistons, plus the extra length of life especially ring groove over a long period has convinced us that we were correct to standardise on them for all our engines. This, in turn, has decided us to standardise on your Al-Fin pistons as original equipment also, and therefore on all new vehicles these pistons will be specified, and by using them from the outset we are convinced we shall benefit."

(MESSRS. WALLACE ARNOLD TOURS LTD. OF LEEDS FAMOUS FOR THEIR CONTINENTAL TOURS HAVE A FLEET OF OVER 200 LUXURY COACHES AND 20 SERVICE BUSES.)

The new motorways have already caused a spectacular number of engine breakdowns. High speed for hour after hour is just *too* much for many engines . . .

Fortunately, AL-FIN armoured pistons can take the hardest possible driving and still *outlast ordinary pistons 2 to 1.* The AL-FIN unique construction is incredibly tough. Satisfied users all over the United Kingdom have proved for themselves AL-FIN durability and economy.

Remember, you will get twice your normal mileage on every vehicle fitted. This means real economy in operating costs. Keep your lorries rolling and earning with AL-FIN armoured pistons.

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"THE CHOICE OF THE EXPERT"

AL-FIN

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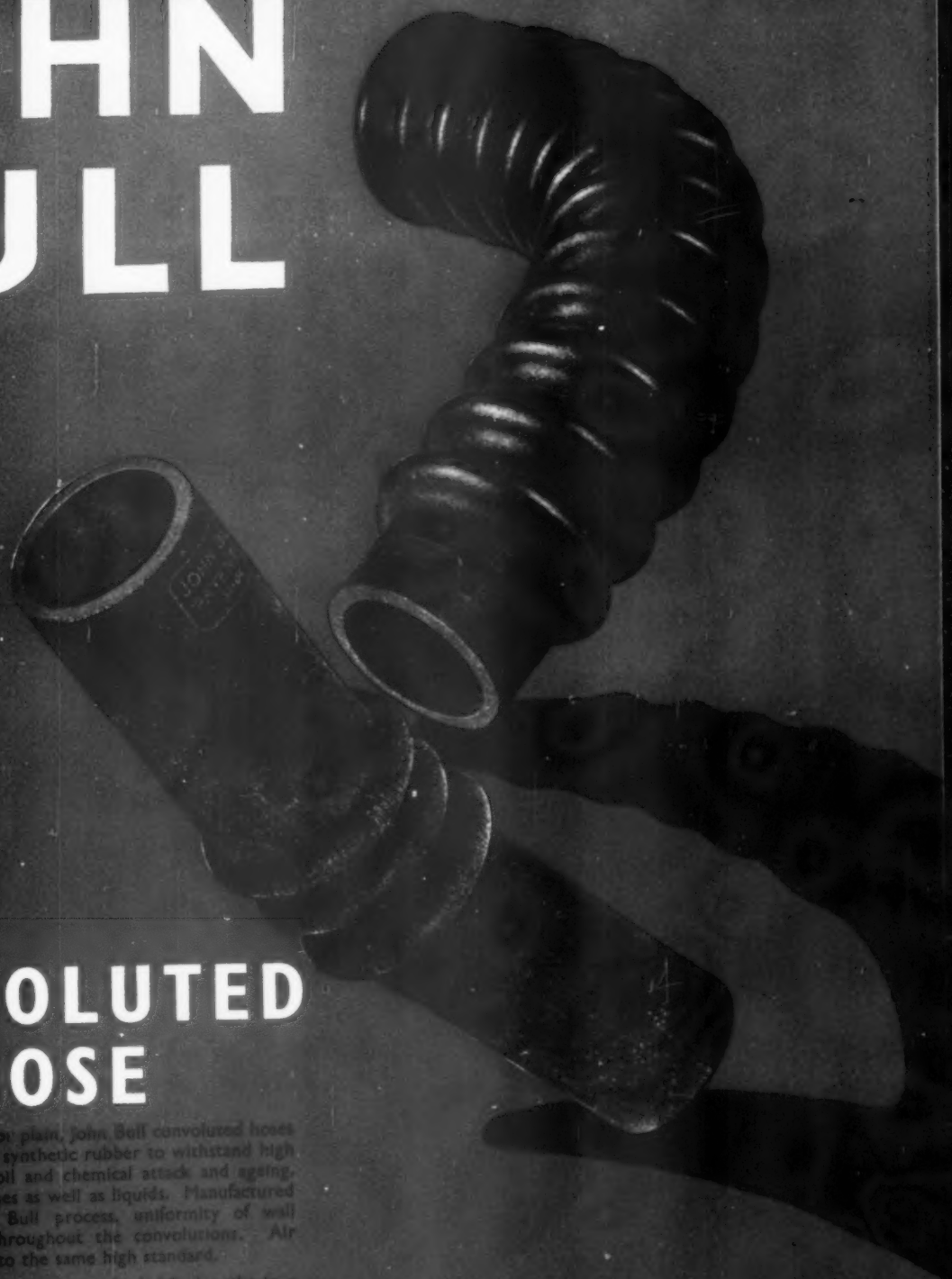

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Stockinette re-inforced or plain, John Bull convoluted hoses are made in natural or synthetic rubber to withstand high and low temperatures, oil and chemical attack and ageing. They are suitable for gases as well as liquids. Manufactured by the patented John Bull process, uniformity of wall thickness is retained throughout the convolutions. Air cleaner hoses are made to the same high standard.

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In addition to Convoluted Hose, John Bull products include Boots and Gaiters, Shaped Hoses and Rubber Mouldings.

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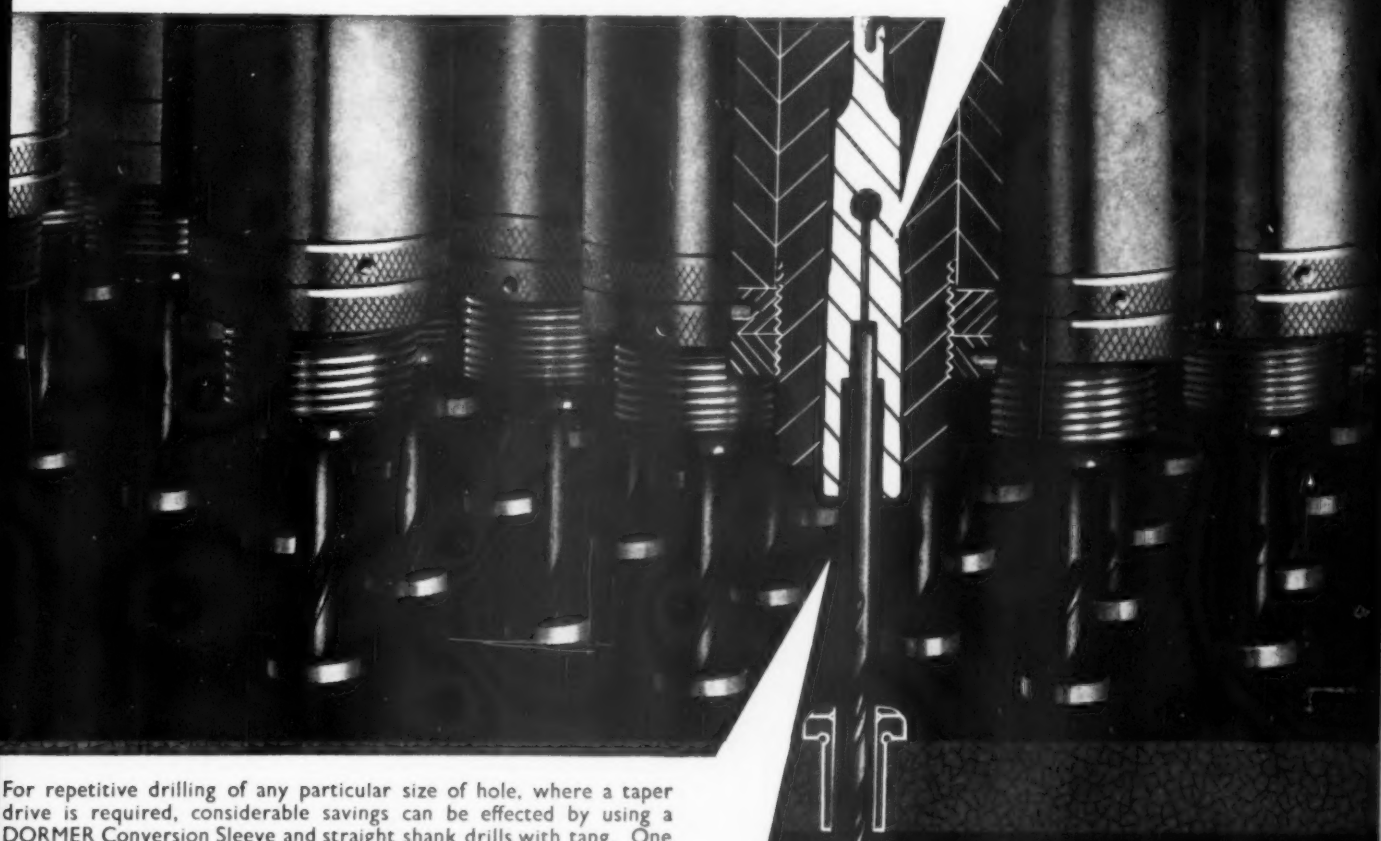
ANOTHER DORMER ECONOMY



For repetitive drilling of any particular size of hole, where a taper drive is required, considerable savings can be effected by using a DORMER Conversion Sleeve and straight shank drills with tang. One sleeve outlasts numerous drills—replacement straight shank jobber drills are cheaper than those with taper shanks.

Additionally this drive permits drilling to much closer centres than with the conventional straight shank drill chucks—more holes can be drilled simultaneously.

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CONVERSION SLEEVES AND TANGED STRAIGHT SHANK DRILLS

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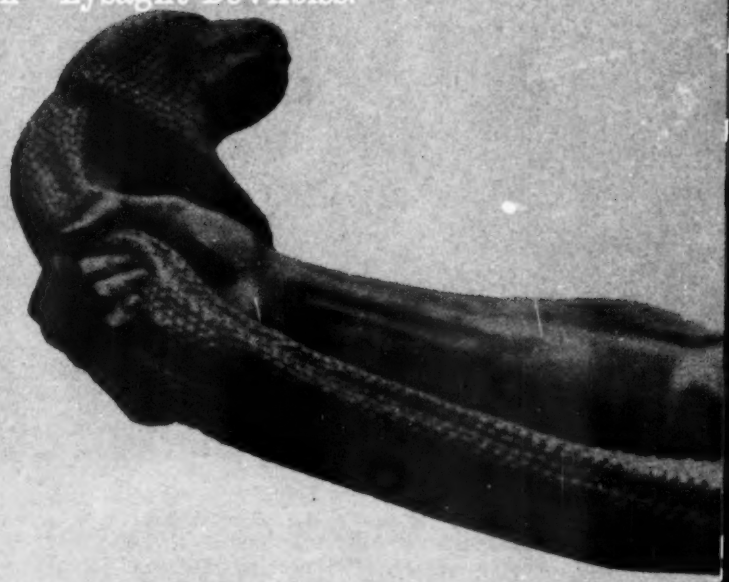

With no narrow interests to serve, Lysaght-DeVilbiss approach a problem with the breadth of vision and dedicated skill born of more than fifty years' specialisation. They design, manufacture and install complete product finishing systems from metal pre-treatment to final stoving. They can offer you a sound, unbiased opinion on the surface coating system best suited to your product. Why not see Lysaght-DeVilbiss now? No obligation, of course.

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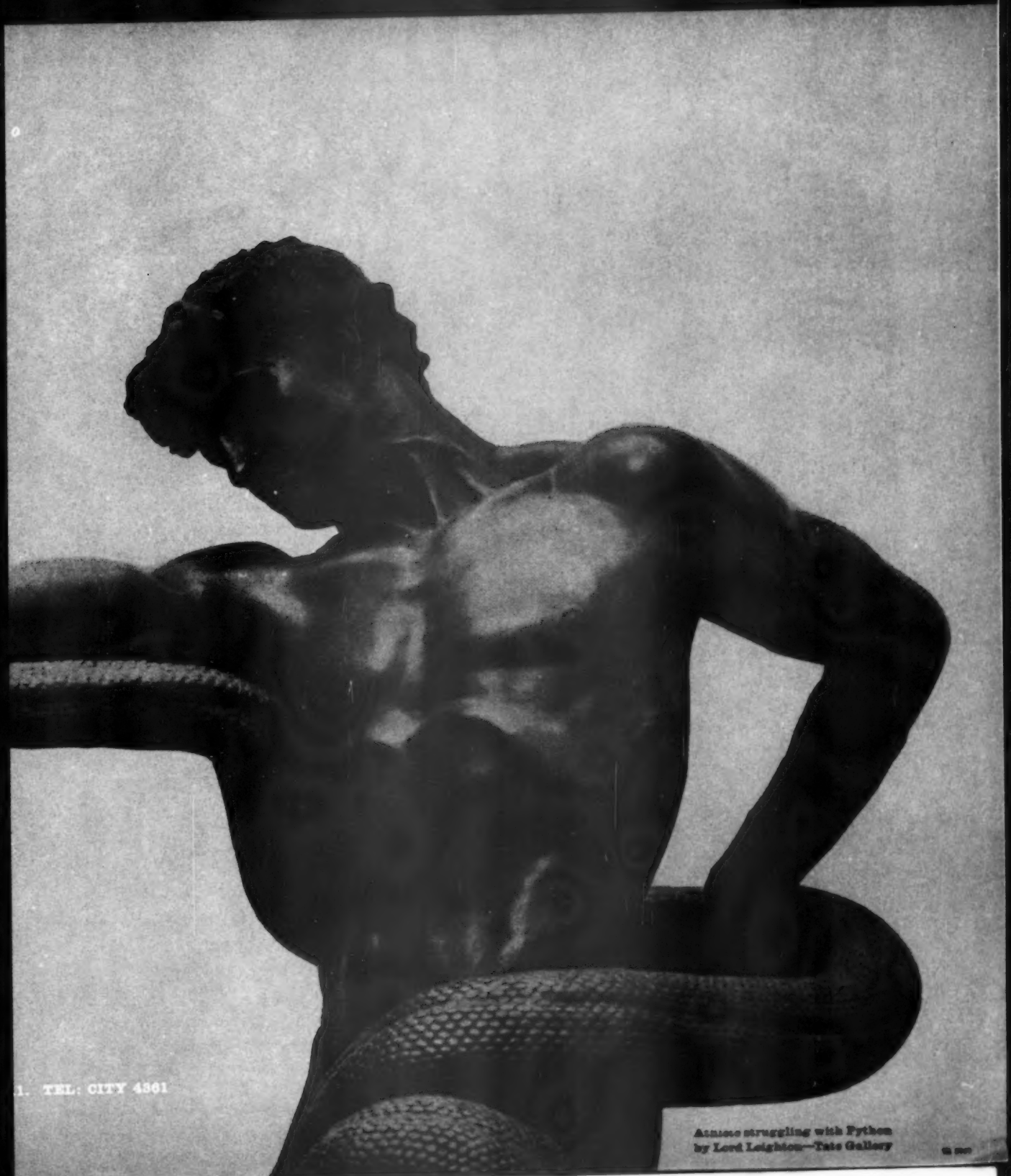
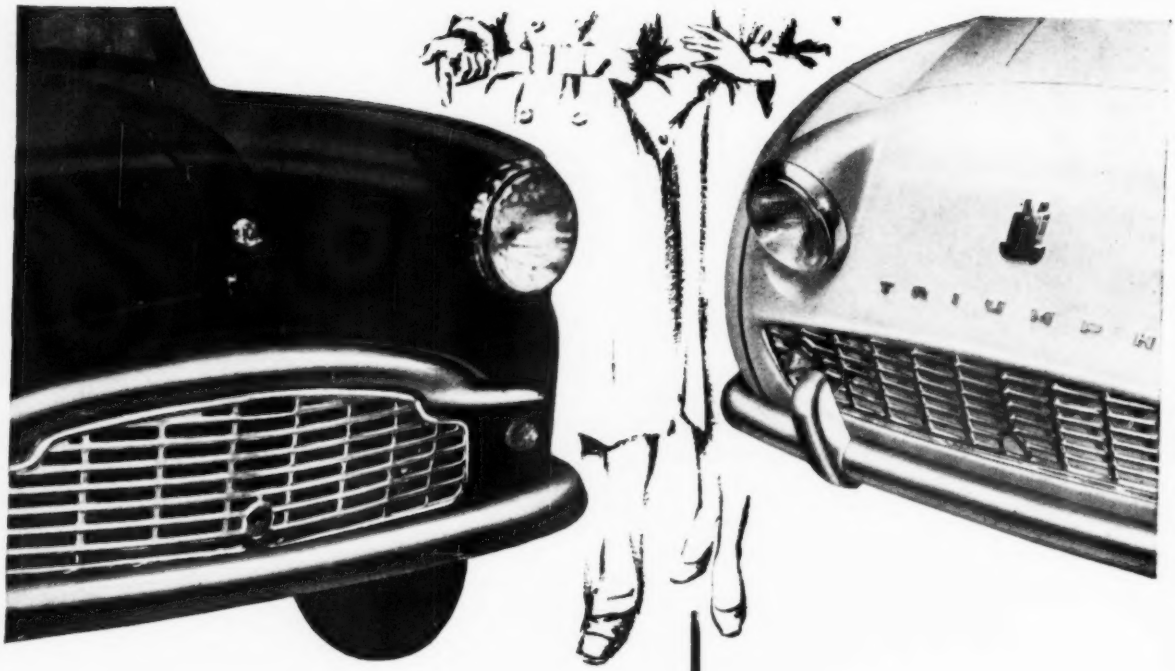


1. TEL: CITY 4361

Atmeo struggling with Python
by Lord Leighton—Tate Gallery



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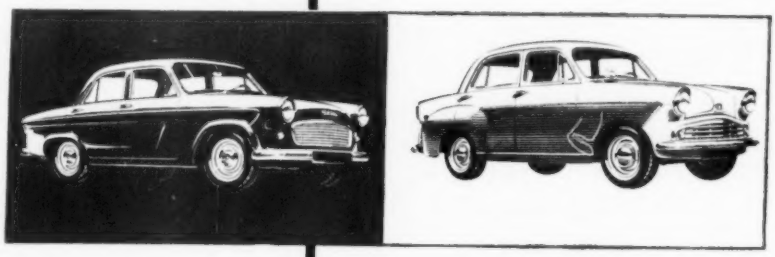
All current models of the Triumph TR.3, Standard Pennant, Standard Ensign and Standard Ten are being fitted with Birmabright aluminium alloy radiator grilles, as a result of the outstanding success of the trials started over five years ago when Birmabright grilles were put into service on the Triumph TR.2. Chemically brightened and anodised by Charles & Watkins Ltd., these grilles are as attractive to look at as they are durable and trouble-free in use.

Write now for full information about the applications of Birmabright aluminium alloys.



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Corrosion-Resisting Aluminium Alloy

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On our new Motorways, transport is setting a new pace—high speed that must be held mile after mile, hour upon hour; high speed that soon seeks out the weak spots. There must be no breakdowns.

High speed demands bearings that run smoothly, reliably, and efficiently-HOFFMANN BEARINGS.

They will do their part in keeping your vehicles running with heavy loads at high speeds with trouble-free performance—
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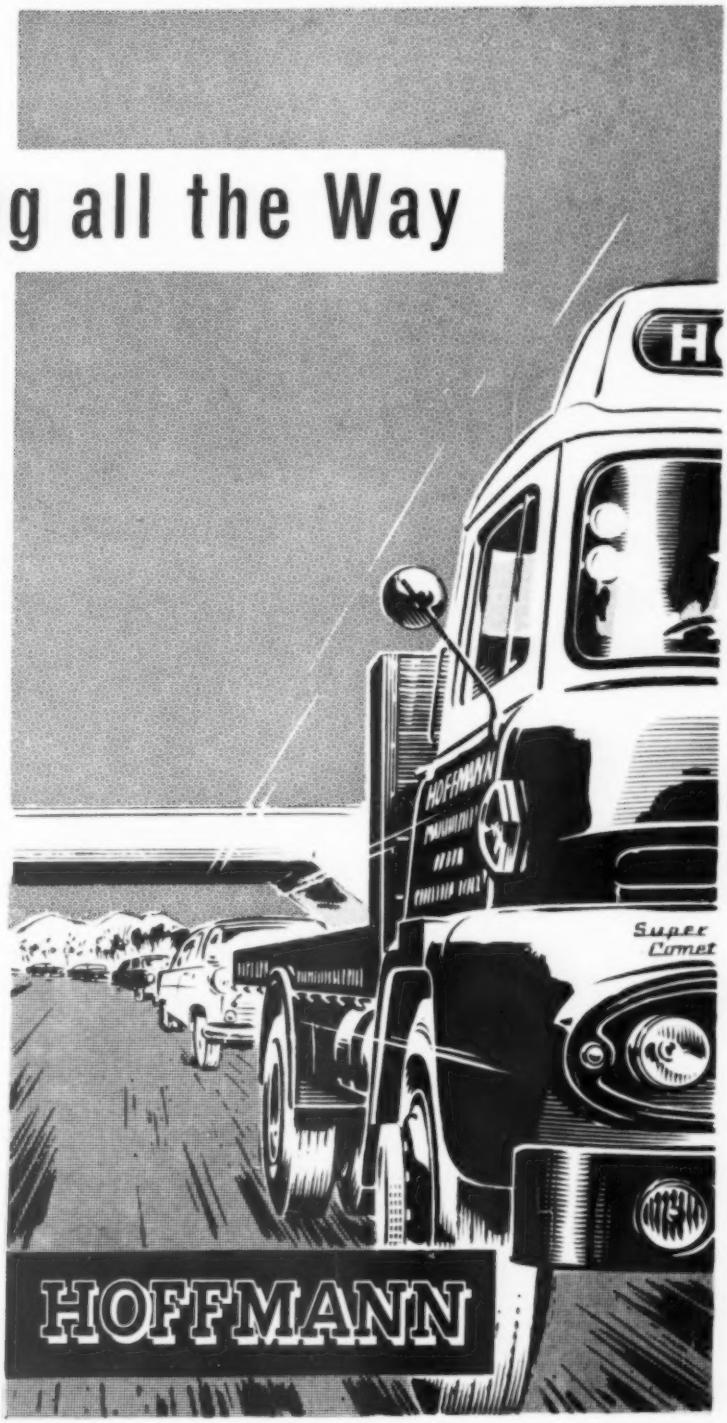

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This machine carries out the following sequence of operations at a *production rate of 150 per hour. Previous methods produced only 200 per day.*

1st Station—Drill 2 holes for u.n.f. tapping.

2nd Station—Tap 2 holes 10 u.n.f.

3rd Station—Drill 2 holes for 6 BA Tapping (Multi-head).

4th Station—Tap 1 hole 6 BA.

5th Station—Tap 1 hole 6 BA.

6th Station—Unload fixture and load fresh component.

Special note should be made of the 2 spindle drilling head attached to the PAR-A-MATIC for drilling the 2 close spaced holes at Station No. 3.

Photograph by courtesy of Messrs. Fry's Diecastings Ltd.

From 200 per *day* to 150 per *hour*—this is the remarkable increase that "ARO-BROOMWADE" Par-a-Matics have effected in the production of automobile door handles for Messrs. Fry's Diecastings Ltd.

Here is but one of many examples where the speed and versatility of "ARO-BROOMWADE" Par-a-Matics makes really substantial savings and increases production.

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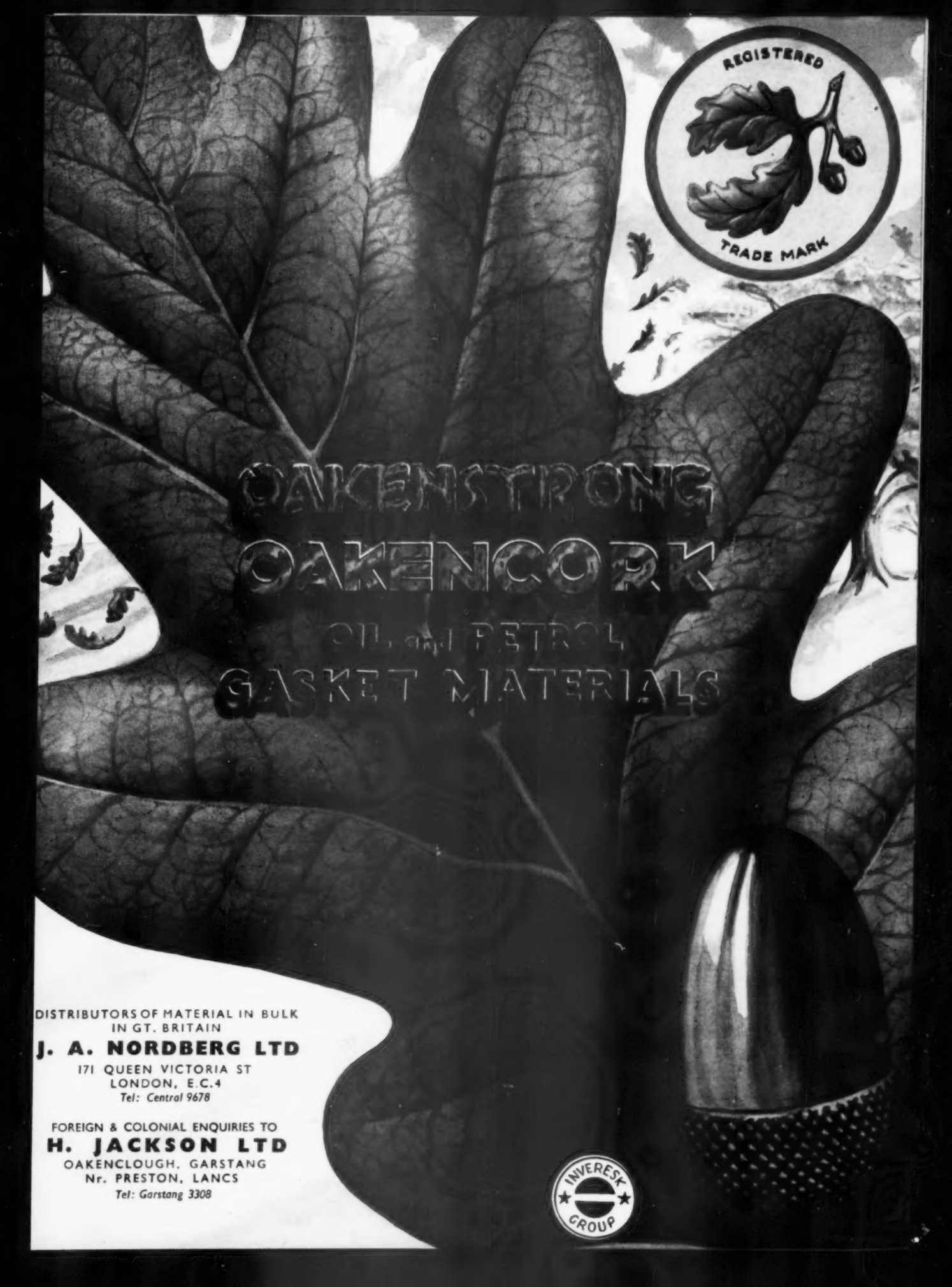

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For Cabs and Bodies

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Metalastik mountings play a double part in damping out vibration and shocks and reducing noise level. They help to give a better ride to the load which may range from the injured in an ambulance to sensitive electronic equipment and they prolong the life of coachwork and tanks by reducing local racking stresses.

The Metacone mounting is used extensively for widely different types of body. Providing substantial deflections with high load capacity, its progressive action and inherent damping are of great value.

Specially designed by Metalastik after long study of the problems involved in mounting cabs, the C.R. mounting is fitted by leading vehicle manufacturers. It reduces transmitted noise, softens shocks and controls rebound. There are many other mountings available. As a trunnion mounting or pivot for tanks, the Metalastik Ultra-Duty bush permits large torsional deflections and supports heavy radial loads. Cushyfoot mountings are ideal for mobile generators, compressors etc., and for lighter loads there is the low-height equi-frequency mounting with built-in rebound control as used for the sub-frame on the Rover 3-litre car.

Ultra-Duty bushes are employed for mounting aluminium tanks by Thompson Bros. (Bilston) Ltd. The Dennis ambulance chassis incorporates eight Metacone mountings to give smoother riding for the injured. Metacone mountings are used on the Tecalemit crashtender for cab and tank but they are larger than those on the ambulance because of severe shock loads on cross-country travel.

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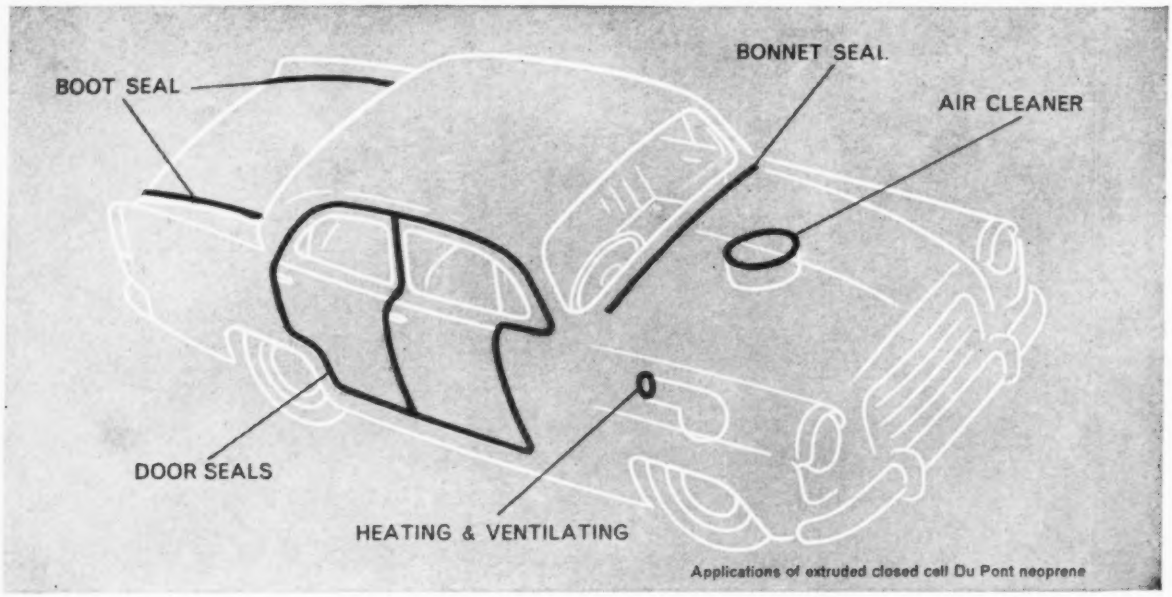
EXTRUDED CLOSED CELL DU PONT NEOPRENE



Applications of extruded closed cell Du Pont neoprene


Examples of complex cross sections which can be extruded

NEW APPROACHES TO BODY SEALING AND GASKETING are possible with extruded closed cell Du Pont neoprene. It can be extruded into low-pressure body seals of controlled softness that offer high resistance to ozone and weathering, and have low water absorbtion. The "self-skin" of these extrusions and the closed cell structure beneath remove the need for a protective coating. Tighter radii can be turned without wrinkling to provide an effective seal. For more information post coupon for your copy of 'Extruded Closed Cell Neoprene Sponge'.

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The Sand-Jet Marking Machine (illustrated above) permanently marks carbide, stainless steel, ceramics, glass and delicate thin-walled articles which cannot be marked by normal methods.

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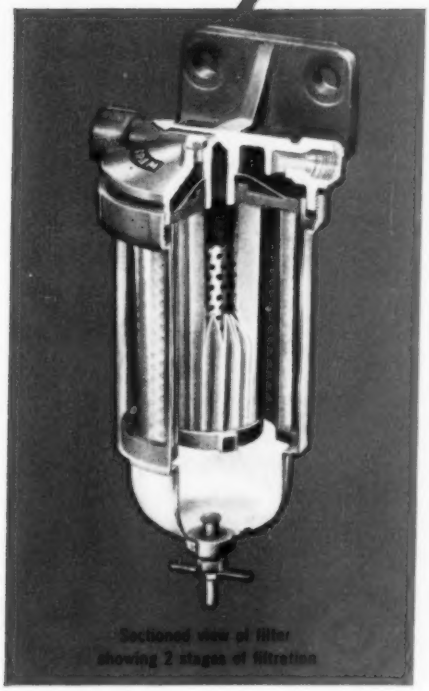
FRAM FOR FORD



Sectioned view of filter showing 2 stages of filtration

FRAM TWO STAGE WATER SEPARATOR FUEL FILTER FOR DIESEL ENGINES

Simmonds Aerocessories Limited supply this new Fram Filter to the Ford Motor Company as an optional extra for diesel-engined Thames Trader Trucks. The filter ensures a perfectly clean stream of fuel, trapping dirt down to five microns in particle size and removing entrained or emulsified water.

Available also for fitment to trucks already in use, the unit is compact and easy to install and the replacement elements can be changed without tools. Send for illustrated leaflet giving full details.

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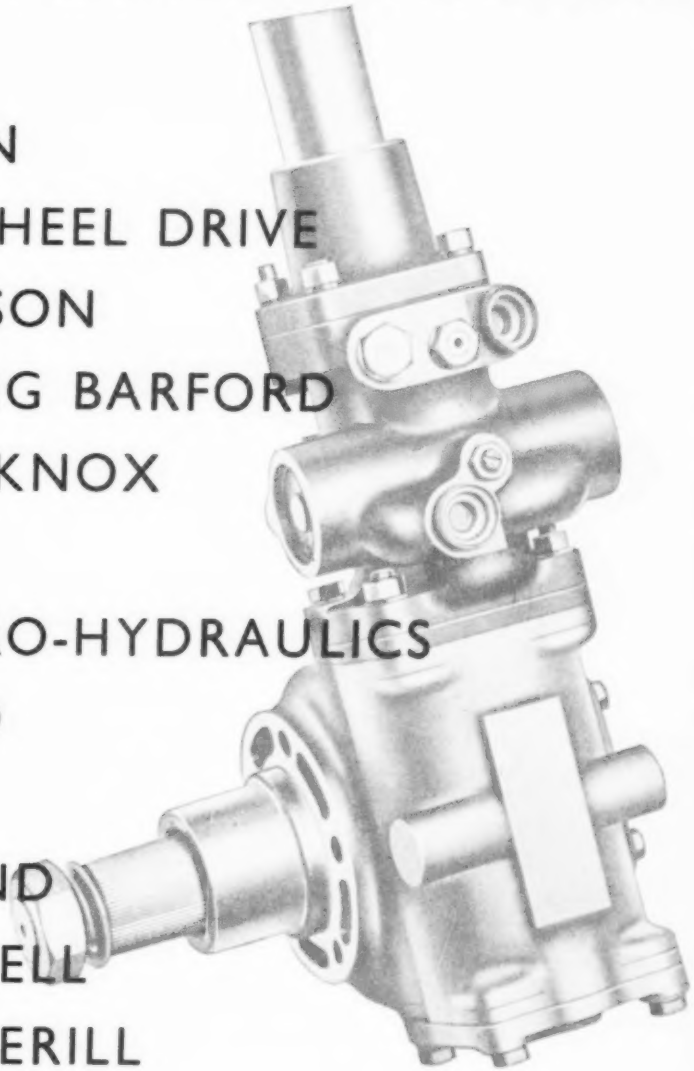

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The right RIVETER for the job... and CP make it!

HERE ARE 6 DIFFERENT CP RIVETERS

One firm needs a riveter for driving home $\frac{1}{16}$" Dural rivets, another for $1\frac{1}{4}$" hot steel rivets on heavy construction work, and in between this vast range of applications are demands for an amazing number of speeds, sizes, weights, lengths of stroke and types of handle. And for *all* these jobs — CP can supply the right tool.

CP in fact make the right riveters *for every* type of work — from shipbuilding to aircraft assembly Six of CP's wide choice of riveters are illustrated here; you can see the full range in the CP 24 page Riveting Tools Catalogue. Send for your copy.

Consolidated Pneumatic

The CP 2 X Aero Hammer for $\frac{1}{4}$" Dural or $\frac{1}{8}$" steel rivets.

The CP 4 X Aero Hammer with Pistol Grip handle for $\frac{1}{4}$" Dural or $\frac{1}{8}$" steel rivets.

CP-2044 one shot Hammer $\frac{1}{8}$" Dural capacity.

CP-40 "Boyer" Hammer, top choice in shipyards, boiler works, etc.

CP Baby "Boyer" Superior. Mainly used for lighter constructional work within the $\frac{1}{8}$" — $\frac{1}{4}$" range.

CP-90 "Boyer" One of the 'heavies' in the range. A long stroke pattern to handle $1\frac{1}{4}$" hot rivets.

CONSOLIDATED PNEUMATIC TOOL COMPANY LIMITED · DAWES ROAD · LONDON · S.W.6

Affiliated and Subsidiary Companies throughout the world.

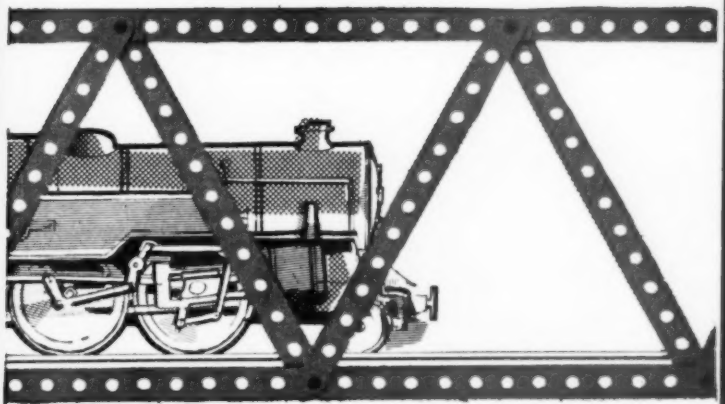
CP/224

running like clockwork

dealing with grown-up affairs, like choosing *coal* to fuel its great powerhouses at Liverpool and Aintree. Coal was chosen because coal provides more heat for the money than any other fuel. Coal, mechanically stoked, is smokeless. And in our coalfields there is enough coal to keep British industry going at top production for generations to come.

When you are required to make a decision about fuel remember Meccano. Coal has helped them to build up a model industry. Choose the same fuel—and you've made the most constructive start.

FORWARD ON COAL



ISSUED BY THE NATIONAL COAL BOARD

Coal Provides the Power at Meccano's factory at Binns Road, Liverpool

Mr. Gibbs, Chief Engineer, comments:

"We at Meccano operate all power and steam process equipment from coal.

The present boiler plant consists of two water tube boilers and economisers fitted with usual mountings, including feed water regulators. These boilers were installed in 1928 and still give us a first-class service today. Their efficiency is high.

Since the original installation we have continued to make improvements. In 1948 further instruments were added, such as CO_2 recorders and indicators and flue gas temperature recorders. A feed water meter was installed in 1955 and soon afterwards a smoke indicator and recorder. More recently the reciprocating feed pumps have been superseded by electrically operated centrifugal pumps.

In this way we have kept pace with the increasing demands of production and made the best use of all our equipment.

Firing is by chain grate stokers and all fuel is handled mechanically. Steam is used for space heating and process work.

Each boiler is opened up for cleaning and inspection once a year. The flues are easily cleaned with a compressed air line, and on completion the boilers work for the following year with practically no maintenance.

Coal is obtained from a local colliery and deliveries are arranged daily to suit our requirements. The quality of the coal is always consistent and we are confident that we shall continue to use coal for years to come."

Here are some key facts and figures about the consumption of coal at Meccano:

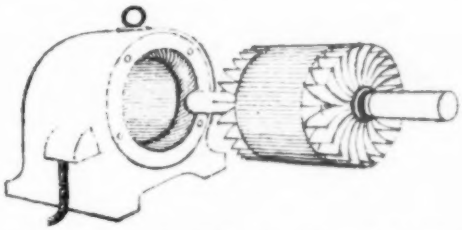
Number of boilers: .....2 water tube
Method of firing: .....chain grate stokers
Steam pressure: .....120 p.s.i.
Continuous max. rating: ...6,500 lbs. per hour
Steam temperature: .....350°F.
Feed temperature: .....180°F.
Annual fuel consumption: ...2,260 tons of coal

Electric Motors & Controls 1

Most manufacturers today employ electric motive power through individual drives, which, among their many advantages, permit the right type of motor to be used for each of various types of machine. The range of motors available—each with its own characteristics–is very large, and the factory executive could well be guided in his choice by the expert views of the motor manufacturer, the installing engineer or his Electricity Board's engineer. The characteristics of the main types of motor are briefly summarised below.

Squirrel-cage Motors

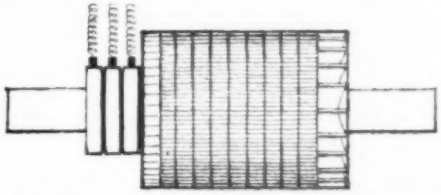
These are the most straightforward and simple in design, and are therefore relatively cheap and robust in character. They should be considered for general duties and, in conjunction with variable-speed gears or couplings, for applications requiring variable speeds, e.g. for crane drives. Small sizes can be switched direct-on-line.



The squirrel-cage motor is very suitable for individual drive of each motion of single-purpose machine tools where the motor horsepower can be precisely specified. It is suitable for driving pumps, fans, lifting hoists and woodworking machines. Textile machinery represents another field of use.

Slip-ring Motors

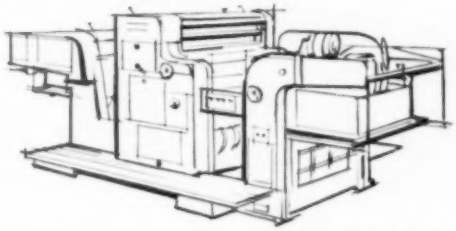
The chief advantage of the slip-ring motor is a very low starting current for a given torque, e.g. full-load torque at starting with a current about 10% above full-load current. This makes it suitable for applications requiring a prolonged starting period with a



load of high inertia. It also permits of speed variation below synchronous speed, though with some loss of efficiency. Typical applications include fans, pumps, heavy lathes, grinders and boring mills, as well as calendering machines, cable-laying-up machines and mine hoists.

Three-phase A.C. Commutator Motors

The main characteristic of this type is variable-speed with uniform and gradual acceleration and good efficiency over the speed range. Paper manufacture provides excellent examples of its use, e.g. in paper-making, reeling, cutting, calendering, coating and drying.



A.C. commutator motors are recommended for mechanised bakeries and for cranes and hoists where very slow speeds are frequently needed.

Synchronous Motors

These are constant-speed motors. One particular advantage is that they can be operated at unity or even at leading power factor to correct a system suffering from lagging power factor, and perhaps so qualify for a reduction in the electricity bill. Pump and compressor drives are typical uses to which they can be put. They are also used in motor-generator sets.

Single-phase A.C. Motors

In general, single-phase motors are used in light industries for drives not requiring more than about five horsepower or where a three-phase supply is not available. While their use is mainly limited to work of a light nature, they do fill a need in such duties as sewing-machine drives, portable hand tools, window opening and closing gear, etc.

Direct Current Motors

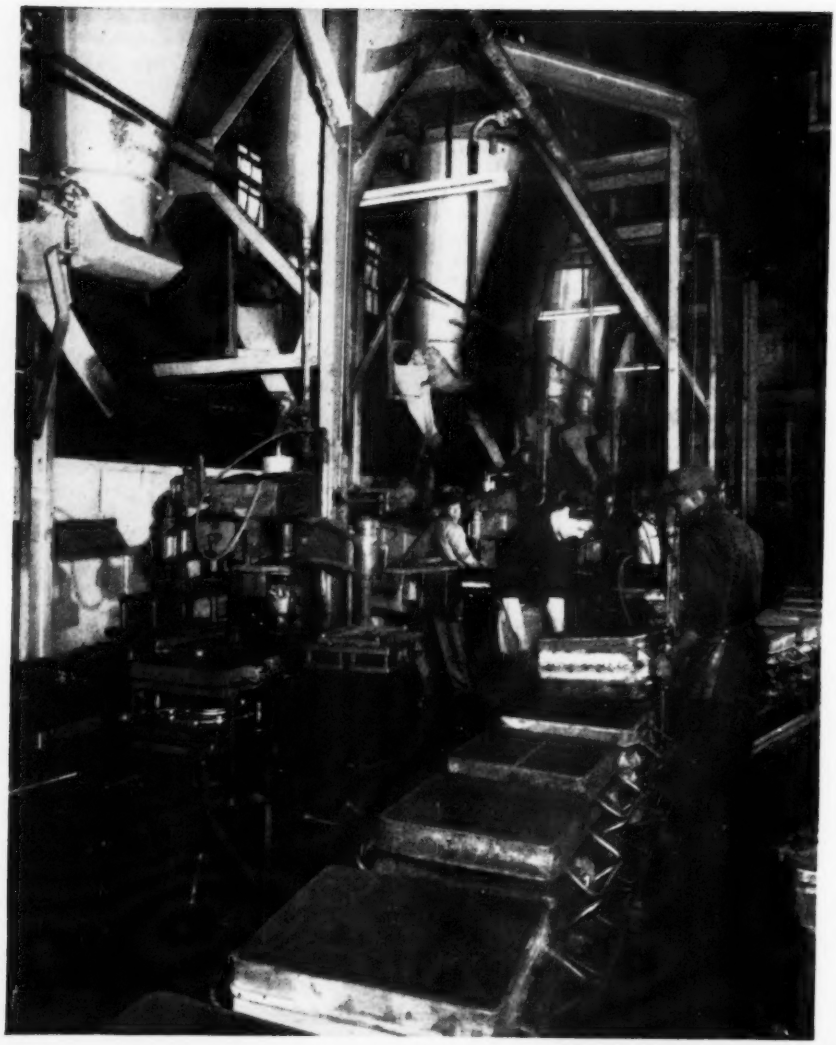
For a completely unfettered performance where wide ranges of speed variation, high rates of acceleration and powerful dynamic braking are all-important, the D.C. motor is unrivalled. This means in effect the installation of an A.C.-D.C. motor-generator set or rectifier to give the necessary supply, but the increased cost may well be compensated by the improvement in productivity. When variable voltage is applied to the armature, a wider speed range is obtainable than with any other type of motor. Typical applications of the D.C. motor are: cranes, haulage and tippler equipment, certain machine tools requiring a large speed range and smooth acceleration, high-speed printing and steelworks drives.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2. TEMple Bar 9434.

They can offer you excellent reference books on electricity and productivity (8/6, or 9/- post free)—"Electric Motors and Controls" is an example.

E.D.A. also have available on free loan within the United Kingdom a series of films on the industrial uses of electricity. Ask for a catalogue.

7914



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The Birlefco medium frequency power-package is a completely self-contained motor generator unit of great versatility. Simply connected to a 50 amp power point, the generator can be used to operate equipment for hardening, annealing, brazing, sintering and a wide range of other heat treatment processes. About 95% of all induction heating applications can be carried out at medium frequency.

- Highest conversion efficiency (up to 86%)
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- Low running costs
- Simple rugged construction

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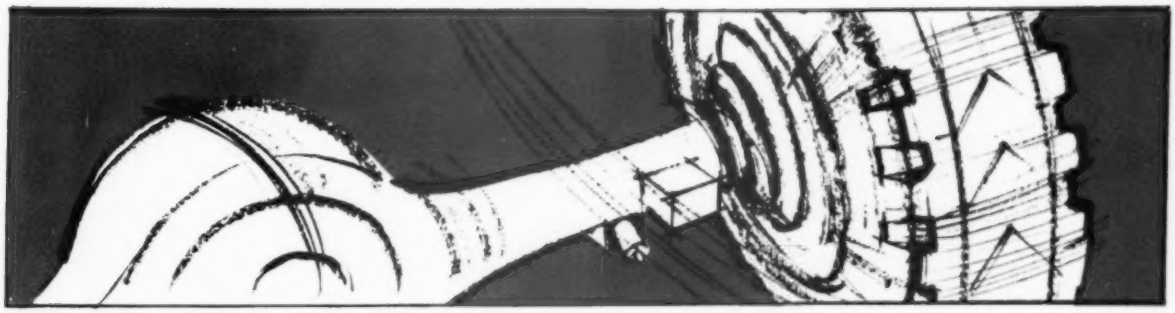
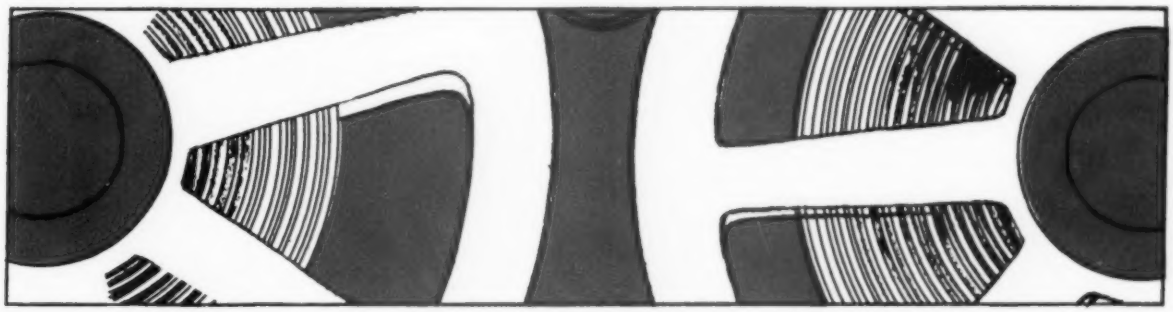
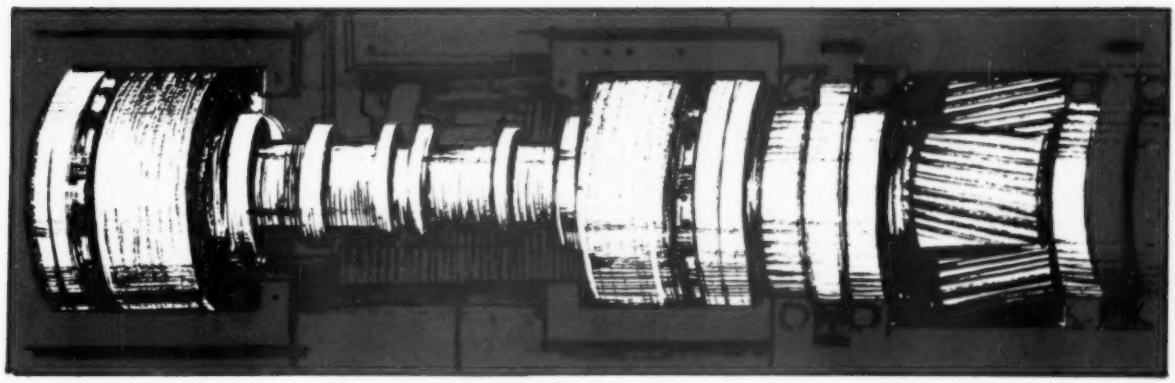


consult R&M bearing experts



when at the prototype stage



As machines grow more complex and performances increase, the selection of bearings becomes more difficult. It requires specialist knowledge.

In increasing numbers, design and development groups are consulting the Technical Department of Ransome & Marles for guidance. Specification as well as supply is part of the R&M service to the engineering industry.

Every enquiry gets equally impartial and confidential consideration. Every project benefits.

Ransome & Marles produce ball and roller bearings for most applications.

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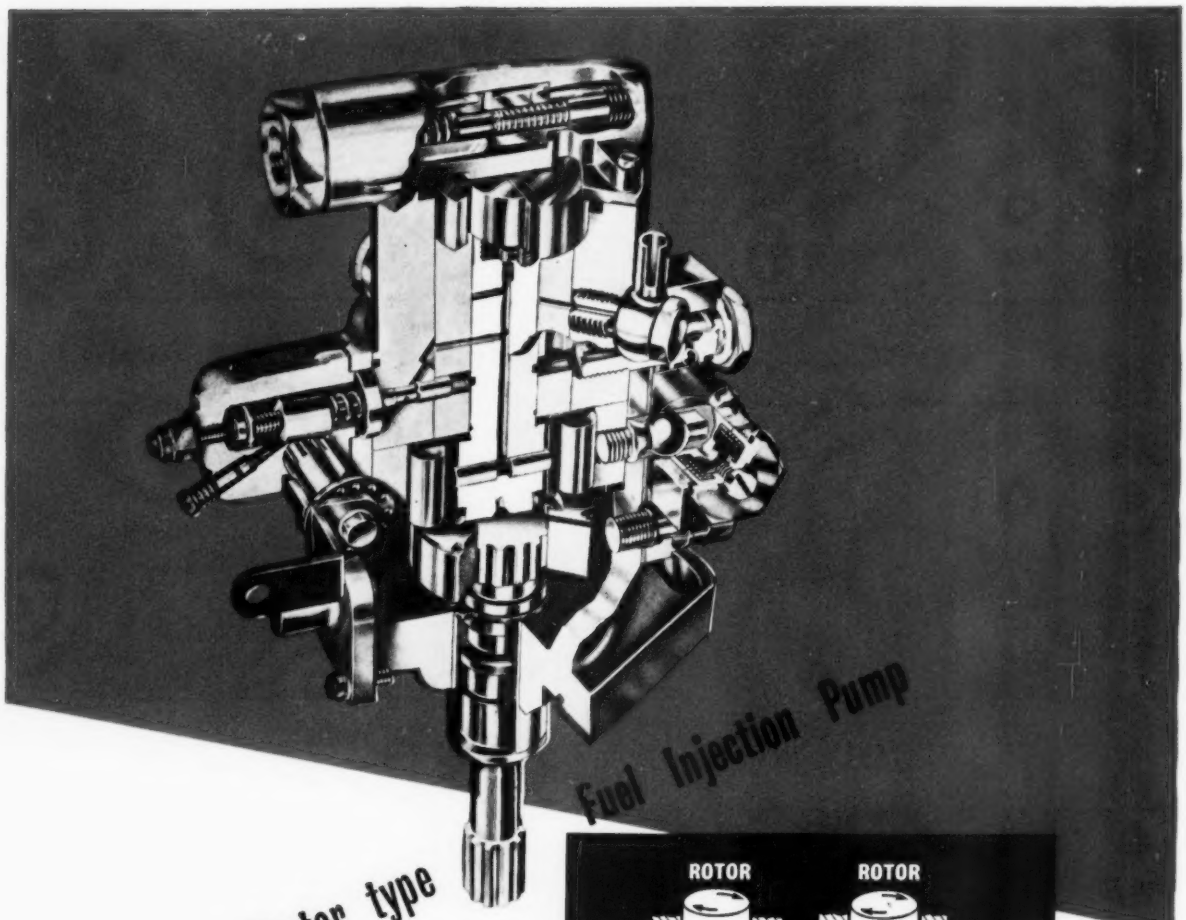
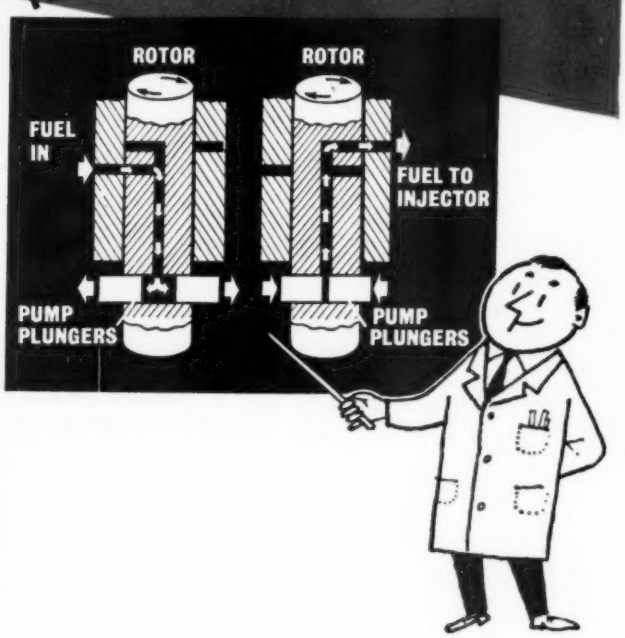


The Distributor type Fuel Injection Pump



THE SIMPLE BASIC PRINCIPLE

The DPA pump is quite simple in operation. It has only ONE pumping element, whatever the number of engine cylinders. Twin opposed plungers carried by the rotor are operated by a cam ring. The rotor is carried in a stationary housing, and drilled ports provide for fuel inlet and discharge. The left diagram shows fuel entering the pumping element on the inlet stroke. As the rotor turns (right), the inlet port is shut and fuel is delivered through one of the connections leading to the injection nozzles. This cycle is repeated for each engine cylinder, the rotor distributing charges of fuel to each outlet in turn. No calibration or phasing adjustments are required.

C.A.V.

The World's Largest Manufacturers of

FUEL INJECTION EQUIPMENT

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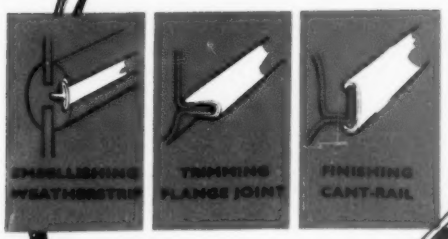
A NEW FREEDOM IN DESIGN



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CLAYLASTIC

the plastic/metal trimming strip

Claylastic by virtue of its flexibility, superb wearing qualities and freedom from damage in assembly, is becoming the natural choice of designers for the external and internal finishing of private cars, commercial vehicles and, in fact, all forms of road transport. Claylastic is found to be the ideal embellishment for glazing rubber, cutting out the need of fillerstrip, and has been established as the perfect finish to flange joints. This material is being used on production lines and has proved its ease of application, and economy in installation. For further details please ask for our brochure Publication 1001.

CLAYLASTIC IS PROTECTED BY BRITISH PAT. No. 801934.

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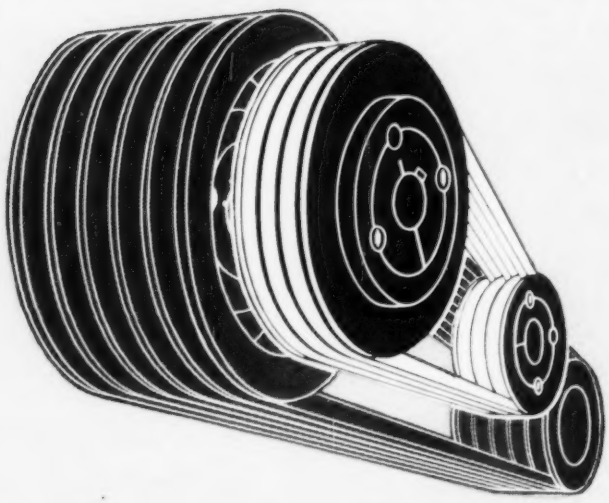
TELEPHONE: WELLESBOURNE 316 TELEGRAMS: 'CLATONRITE' WELLESBOURNE

V-Belt Drive and WEDGE-Belt Drive for the same job



Fenner SpacesaVer Wedge-Belt Drives are

SLIMMER, LIGHTER, SHORTER, CHEAPER

- Width and weight now reduced by a half, and cost by at least a fifth, without loss of strength or durability.
- Modern materials and a new belt section give a much greater power capacity. SpacesaVer Wedge-Belts make full use of the strength and flexibility of Terylene cords. These are bonded to a synthetic rubber which keeps them exactly where they can do most work with least stress to themselves. This rubber provides heat and oil resistance and adequate electrical conductivity at no extra charge. New pulley designs take full advantage of modern casting methods to give stronger, yet lighter pulleys. All have Taper-Lock quick and easy fixing facilities.
- Two Wedge-Belt sections, $\frac{3}{8}$" (Alpha) and $\frac{5}{8}$" (Beta) cover all normal drives up to 200 horse-power. Belt lengths and pulley diameters are based on International Standardisation principles. Your complete drive design can be selected from a single line reading in the SpacesaVer catalogue 135/20. Send for it now.

THE GREATEST ADVANCE IN DRIVE DESIGN FOR 30 YEARS

HERE IS THE PROOF

DRIVE		MOTOR PULLEY DIAM.	DRIVEN PULLEY DIAM.	FACE WIDTH	V-BELTS AND WEDGE-BELTS USED	CENTRE DISTANCE	DRIVE LIST PRICE	DRIVE WEIGHT LB.
5 H.P.	V-Belt	$3\frac{3}{4}$	$6\frac{3}{8}$	$3\frac{1}{4}$	5—A29	7·5	£6 · 8 · 7	16·7
	Wedge-Belt	3·15	5·60	$1\frac{1}{2}$	3 Alpha 280	7·1	£5 · 3 · 8	10·6
	SAVING	**16%**	**12%**	**54%**	—	**5%**	**19%**	**36%**
25 H.P.	V-Belt	$6\frac{1}{2}$	$12\frac{1}{2}$	$5\frac{7}{32}$	6—B65	18·7	£17 · 0 · 7	66·8
	Wedge-Belt	5·3	10·6	$2\frac{23}{32}$	6 Alpha 560	15·3	£11 · 11 · 6	36·2
	SAVING	**18%**	**15%**	**48%**	—	**18%**	**32%**	**45%**

SpacesaVer WEDGE-BELT DRIVES

Catalogue 135/20 details drives up to 200 h.p. Send for it **NOW!**

NAME AND POSITION .....

FIRM'S ADDRESS .....

MADE ONLY BY

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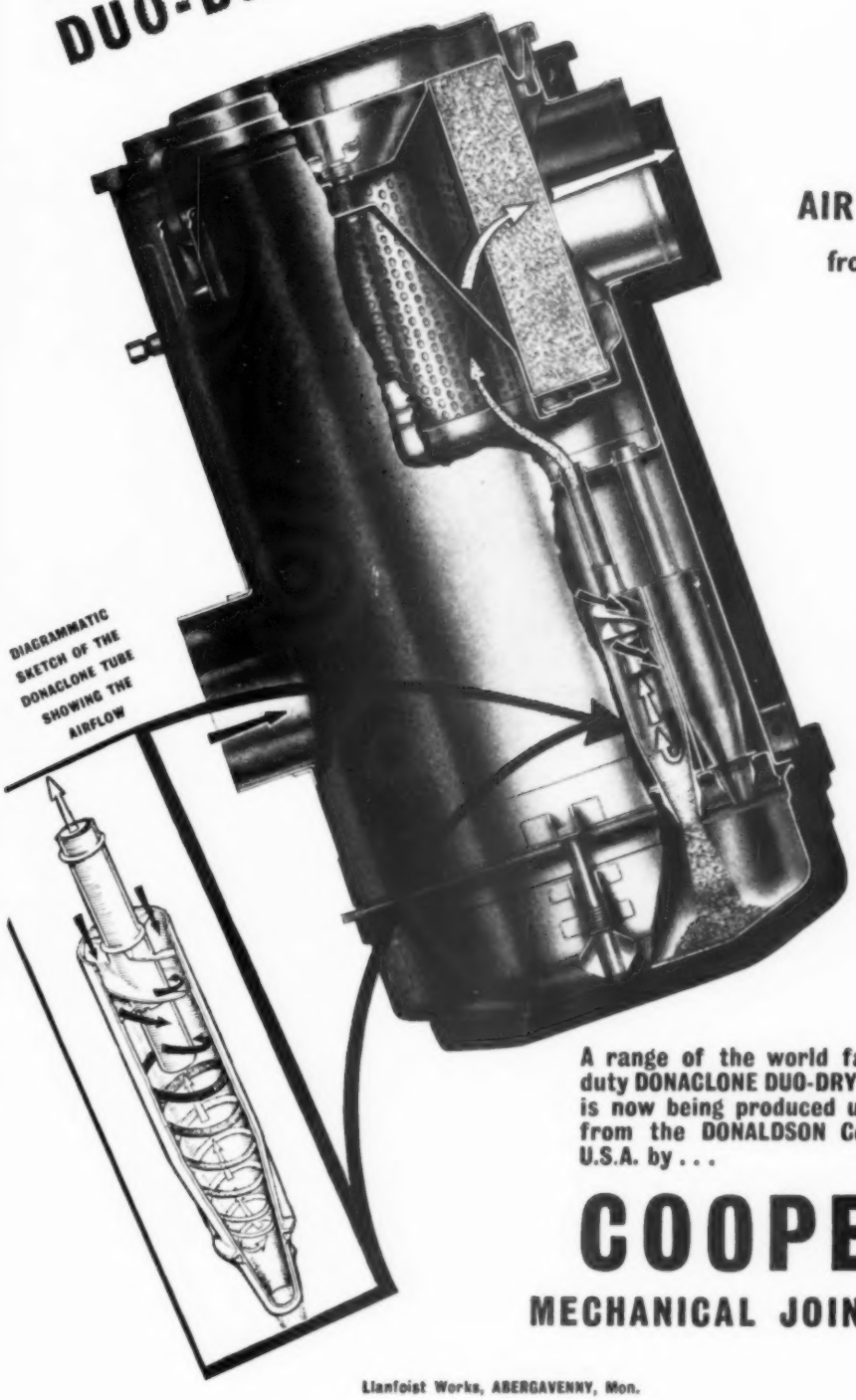
THE LARGEST MAKERS OF V-BELT DRIVES IN THE COMMONWEALTH

DONACLONE
DUO-DRY AIR CLEANERS

A NEW HIGH LEVEL IN HEAVY DUTY AIR CLEANER PERFORMANCE



DIAGRAMMATIC SKETCH OF THE DONACLONE TUBE SHOWING THE AIRFLOW

AIR FLOW CAPACITIES
from **450** to **950** c.f.m.

Up to **98%** of foreign particles are removed by the primary centifruge stage, with the Long Life paper element bringing the overall efficiency up to **99.9%** as tested to B.S.S. 1701

Alternative tubular side inlets and outlets are available at various angular positions.

A range of the world famous heavy duty DONACLONE DUO-DRY Air Cleaners is now being produced under license from the DONALDSON Company Inc., U.S.A. by . . .

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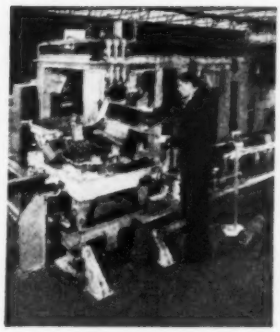
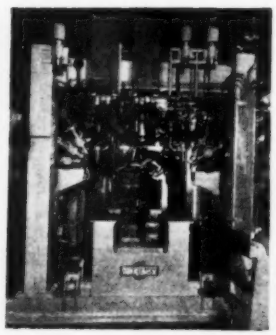
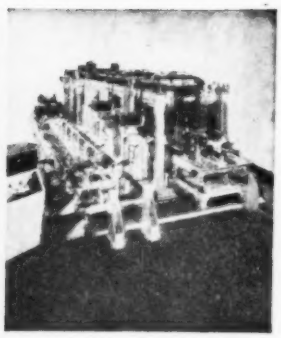
MECHANICAL JOINTS LTD

Llanfoist Works, ABERGAVENNY, Mon. Telephone 1843

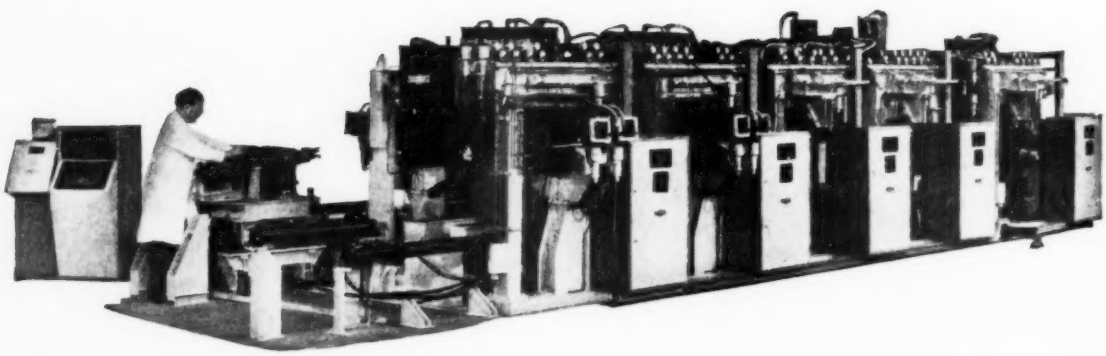
Illustrated is a transfer resistance welding machine, recently designed and constructed by Sciaky. It welds the front suspension and engine mounting units of the BMC mini cars in 5 stages. Welding cycle and transfer between stages is automatic. 3000 units per 40 hour week production.







a welding machine... ...a production line



Every day thousands of Sciaky Resistance Welding Machines are used to produce Britain's automobiles. Working closely with the motor industry, Sciaky has developed a range of welding machines to meet their critical requirements. But, the story does not end there . . . the adaptation of resistance welding to a specific application—the Sciaky technique—is yours for the asking. Let Sciaky experience and know-how work for you, because Sciaky resistance welding techniques are developed to meet your individual needs—whether portable, pedestal, or complete production line.

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SCIAKY

resistance welding means

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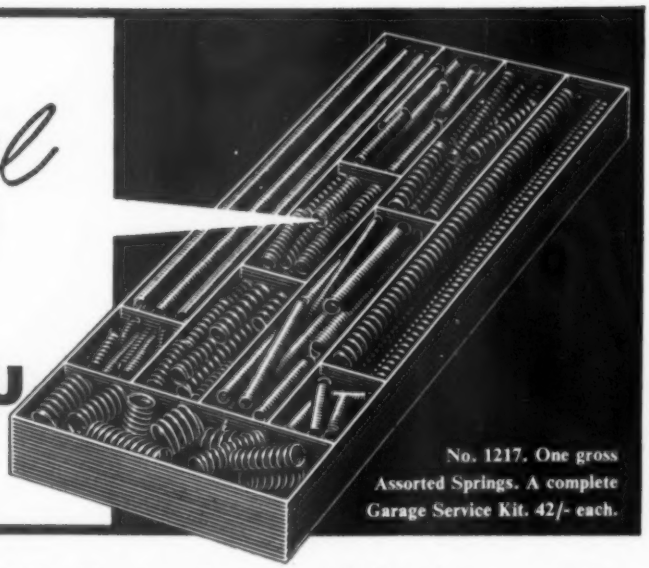
THAT *Experimental Spring* YOU WANT IS WAITING FOR YOU IN THIS BOX...



No. 1217. One gross Assorted Springs. A complete Garage Service Kit. 42/- each.

If not, try another box in the Terry Assorted Springs range

No. 1200. Three dozen Assorted Light Expansion Springs, suitable for carburettor control, etc. **13/6.**

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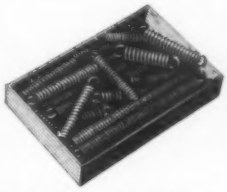
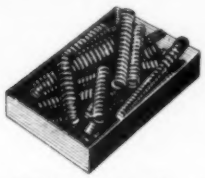


No. 753. Three dozen Assorted Light Expansion $\frac{1}{4}$" to $\frac{1}{2}$" diam., 2" to 6" long, 22 to 18 S.W.G. **10/6.**



No. 760. Three dozen Assorted Light Compression Springs. 1" to 4" long, 22 to 18 S.W.G., $\frac{1}{4}$" to $\frac{1}{2}$" diam. **6/6.**

No. 757. Extra Light Compression, 1 gross Assorted, $\frac{1}{8}$" to $\frac{1}{4}$" diam., $\frac{1}{2}$" to 2$\frac{1}{2}$" long, 27 to 19 S.W.G. **15/-.**

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We know *exactly* how difficult it is to find springs for experimental work . . . we've been making quality springs for over 100 years. So, we confidently offer you our excellent range of small boxed assortments which covers a very wide range.
We can only show a *few* boxes. Send us a p.c. for our full list.
If ever you are stuck with a spring problem let our Research Department put their long experience at your disposal.

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Cut Production Costs with Terry's Wire CIRCLIPS. We can supply immediately from stock—from $\frac{1}{4}$" to $\frac{1}{2}$".

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HERBERT TERRY & SONS LTD

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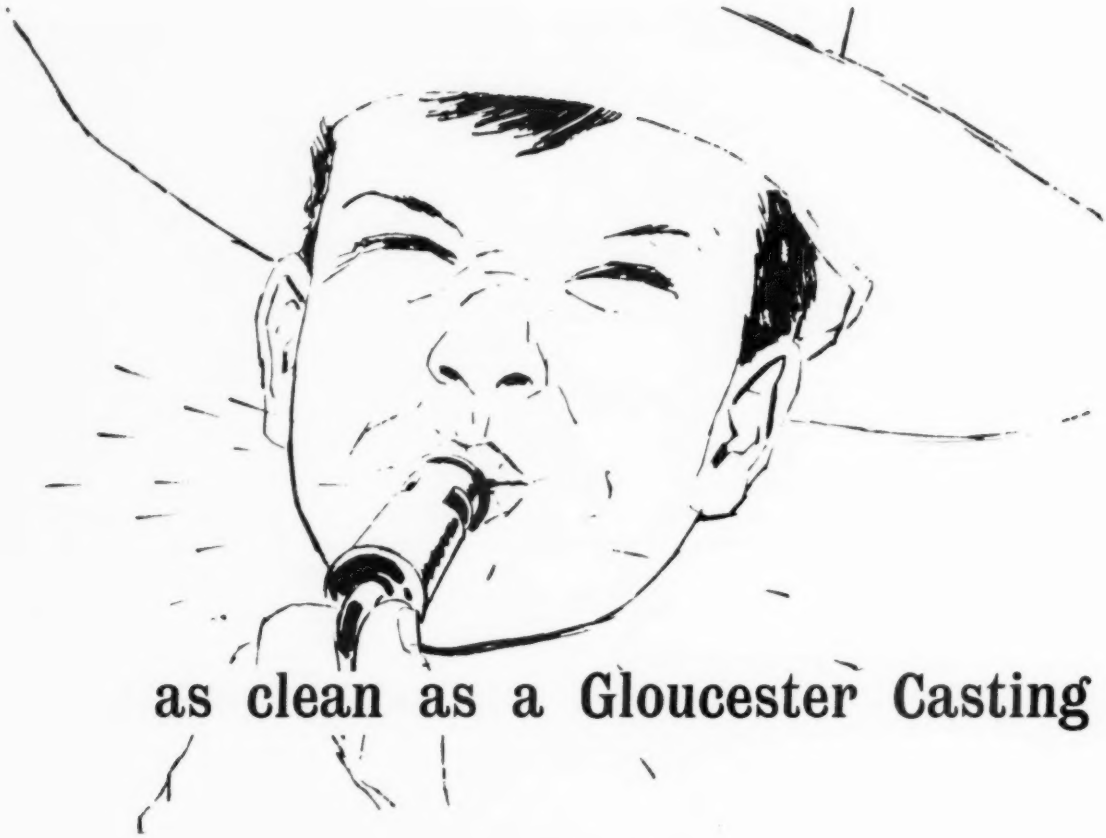
(Makers of Quality Springs, Wireforms and Presswork for over 100 years)

HT90



as clean as a Gloucester Casting

Brake shoe for small vehicle in Malleable Iron.

Bearing bracket in Malleable Iron. Weight 3¼lbs.

"As clean as a Gloucester Casting" means that Gloucester malleable iron castings are of high definition, true to pattern, cleaner and smoother because of better sand practice and better fettling.
Mould and core sands and their bonding additives are under constant laboratory supervision, even the very sand grains are sized and numbered, and consistency and distribution of sand are strictly controlled by a continuous mechanical unit. The high refractory characteristics prevent sand "burn-on" at re-entrant angles, thus greatly increasing the life of cutting tools during the machining process. The new elevator-type electric furnace anneals in 48 hours · —instead of the usual 7 days. It also allows greater icontrol of the component during annealing, resulting n uniformity of metal, greater strength, and resistance to impact.

A typical Gloucester Malleable specification.

Gloucester Blackheart Malleable	*Gloucester Lamellar Pearlitic Malleable*
Elongation .. 18%	Elongation .. 5%
Yield Point .. 12 tons	Yield Point .. 24 tons
Tensile Strength 25 tons psi	Tensile Strength 35 tons psi

GLOUCESTER
THE HOME OF
GOOD CASTINGS

GLOUCESTER

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(A subsidiary of the Gloucester Railway Carriage & Wagon Co. Ltd.)

The most thorough road-test of all

— makes certain these petrols suit today's motorist

BP Premium Petrols (BP Super-Plus and BP Super) are the *most tested petrols in the world.* They are tested in laboratories . . . to make certain they give easy starting . . . yield maximum horsepower . . . eliminate knocking . . . run cleanly. And they are tested on the road as well. *To ensure they give top performance under all the conditions experienced by the modern motorist.*

The amazing superiority of BP Premium Petrols is solidly based upon way-ahead technical research. At the remarkable BP Research Station at Sunbury-on-Thames, scientists in many fields work incessantly to make sure that BP Premium Petrols are the finest available.

If you would like to know more about the technical reasons for the outstanding qualities of BP Premium Petrols, send for a copy of the strikingly illustrated FREE booklet "Behind Every Pint of BP Petrols." Fill in and post the coupon on the right today.

What's going on in the picture?

The car seen going out on test is fitted with a Sunbury Road Test Panel, which measures engine speed and ignition spark advance – it's particularly used for anti-knock testing. BP Research cars are often taken on a 'simulated city traffic' run. In this the driver makes all the stops, starts, quick accelerations etc. that would be necessary in heavy traffic. So BP scientists ensure that BP Petrols give peak performance *under all conditions.*

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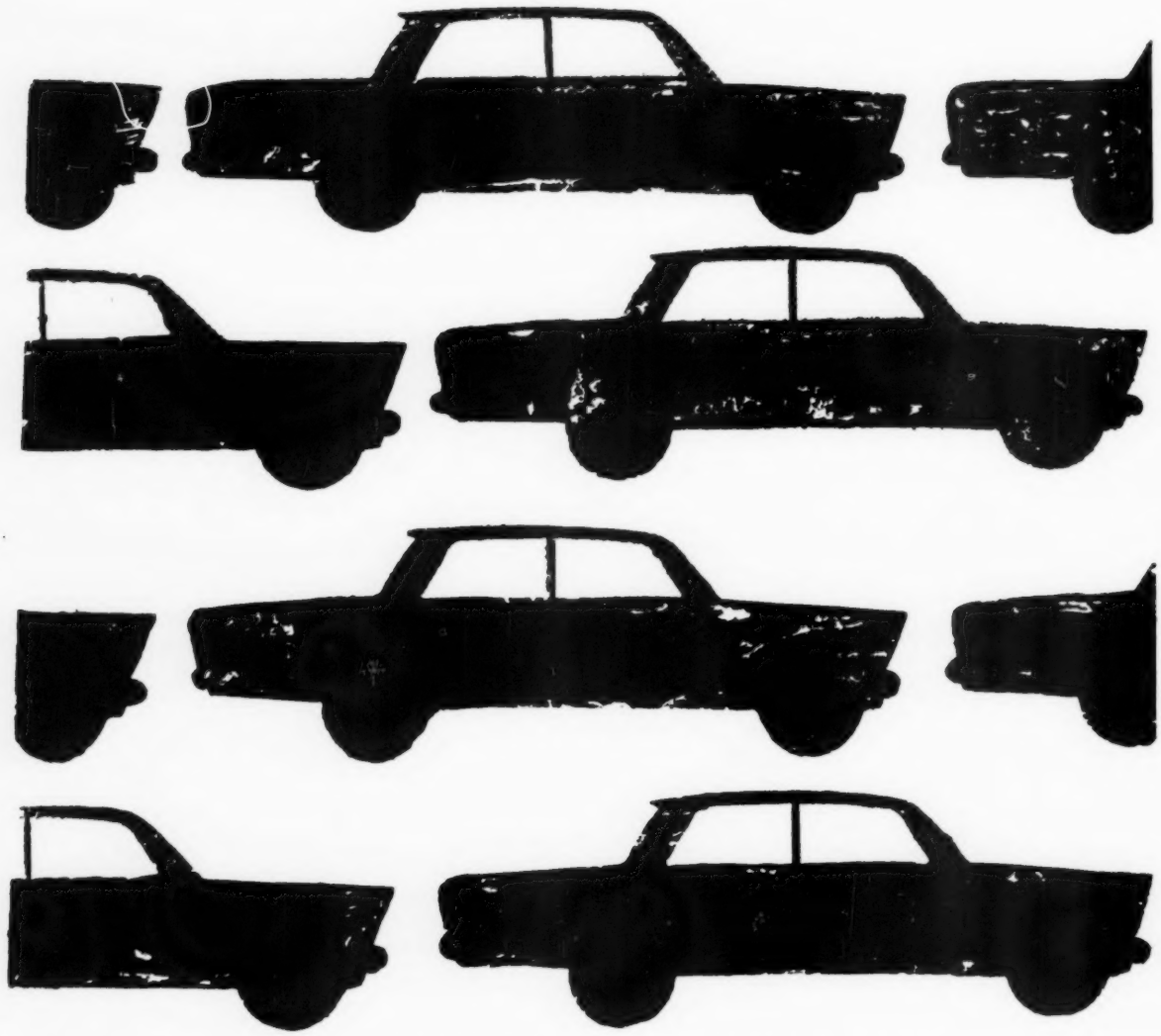

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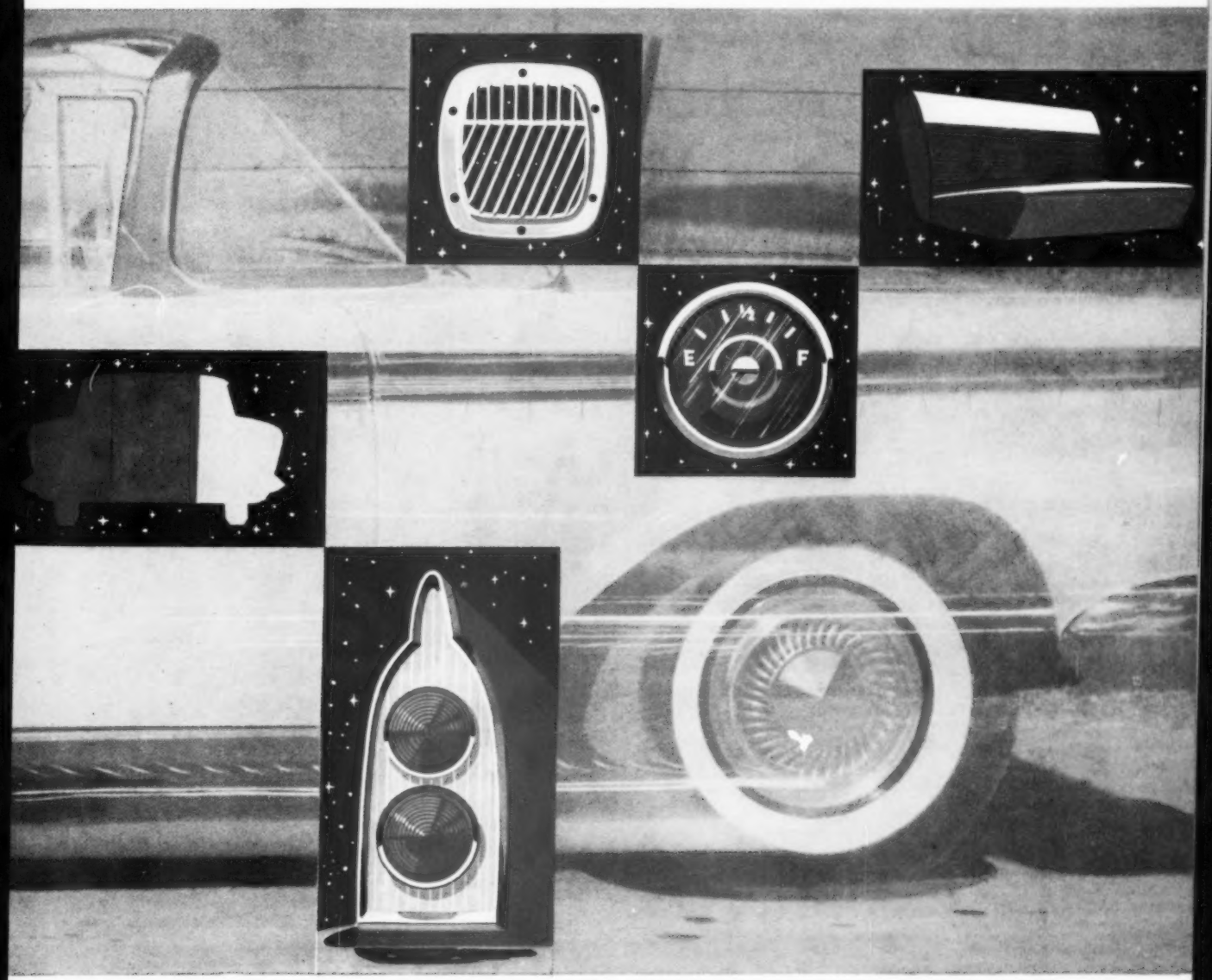

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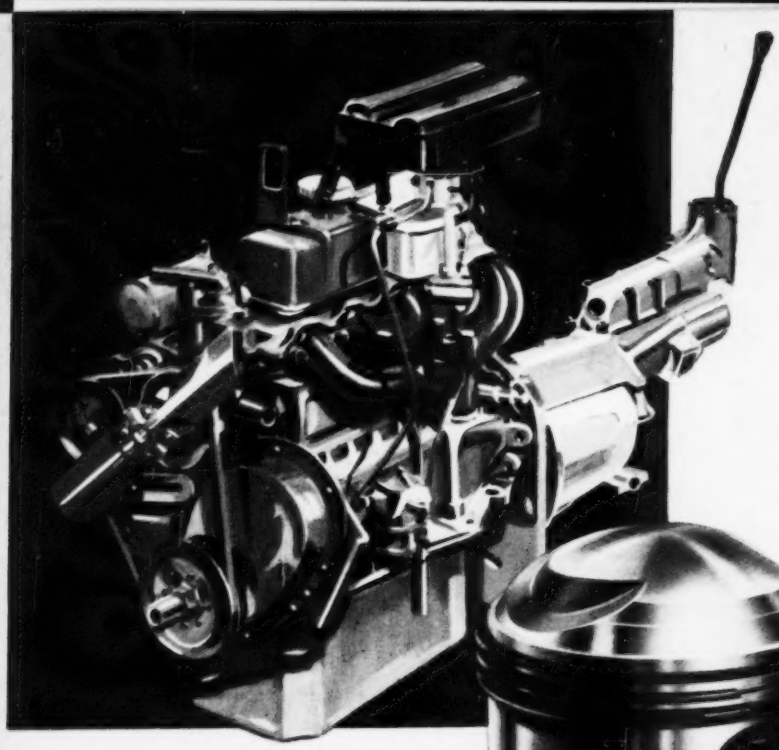

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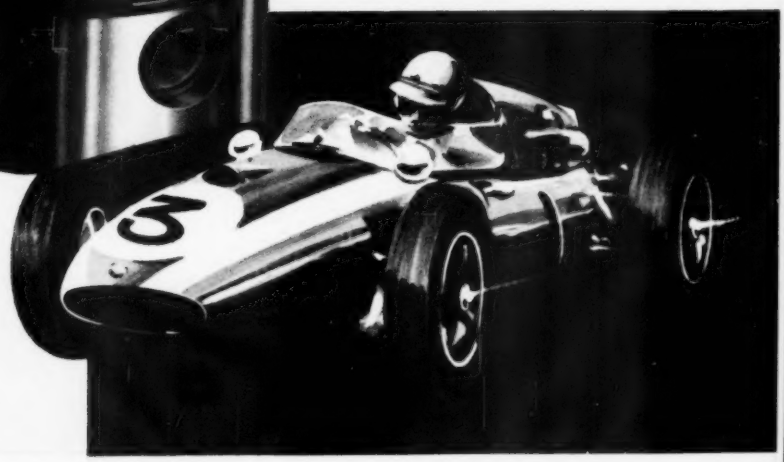

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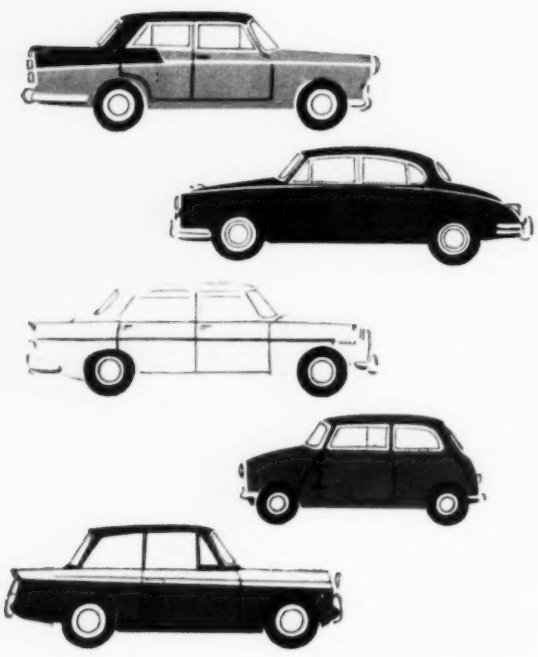

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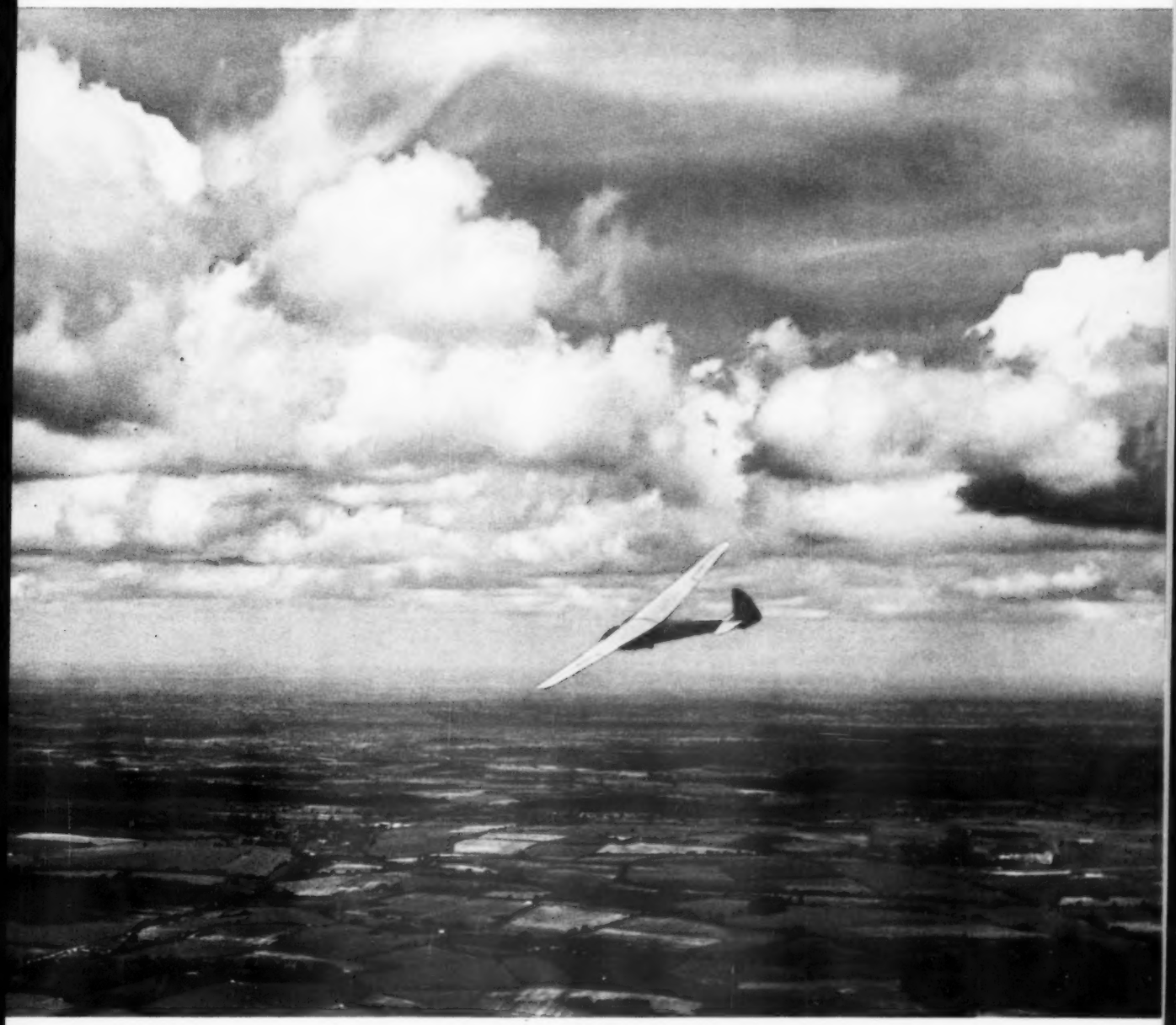
helps smooth out problems



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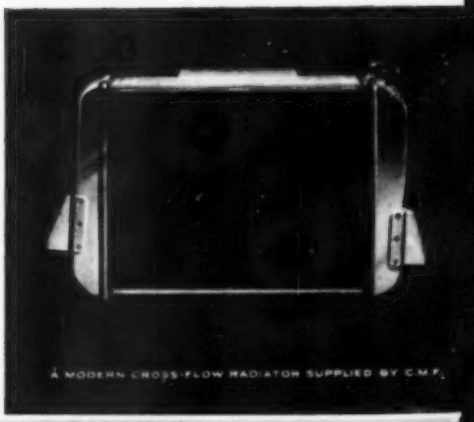

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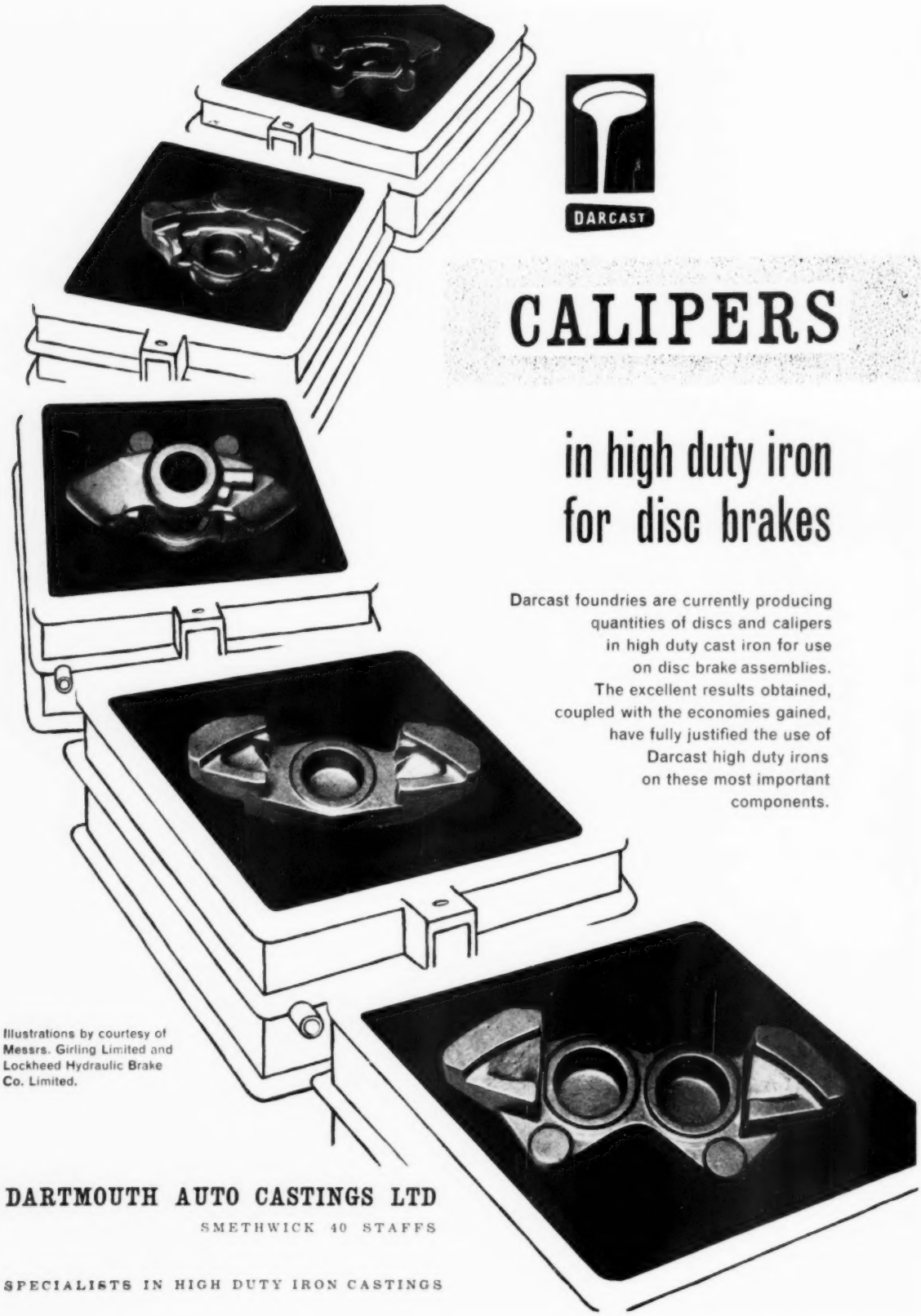

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AUTOMOBILE ENGINEER

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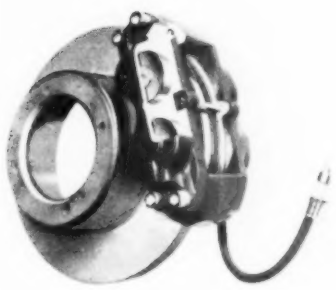

CONSIDERABLE PROGRESS IS BEING MADE WITH DISC BRAKES. THIS IS THE LOCKHEED UNIT WITH THE CALIPER SECTIONED TO SHOW THE TWIN CYLINDERS OF THIS BRAKE

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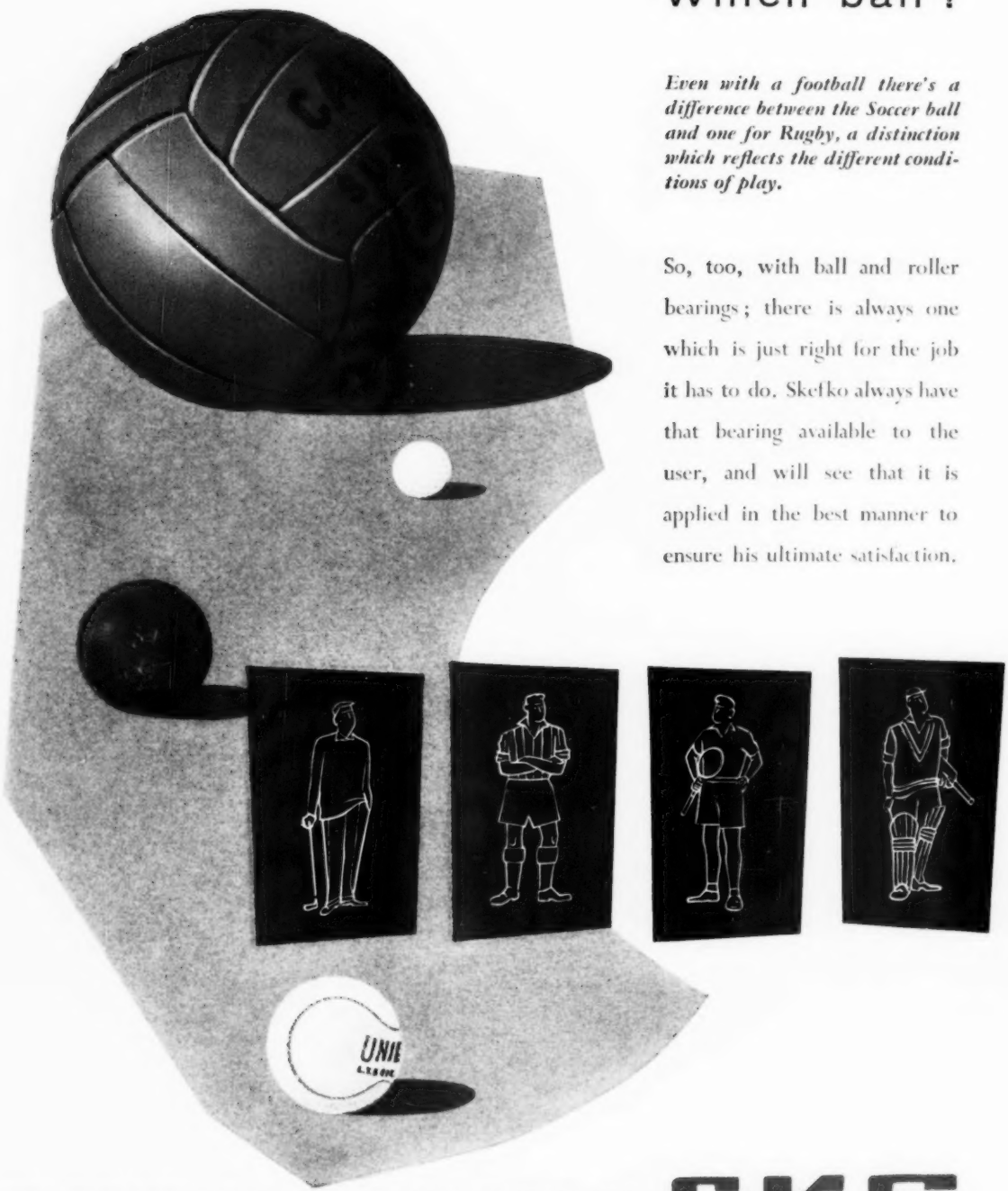

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DESIGN MATERIALS **AUTOMOBILE ENGINEER** PRODUCTION METHODS WORKS EQUIPMENT

Commercial Vehicle Progress

ONE of the most interesting aspects of the commercial vehicle exhibition this year has been the breaks with the conventional in respect of new chassis layouts. One of these is the transverse, rear engine arrangement for double-deck buses. It has the advantage of enabling a low floor level to be obtained; also, the weight distribution, with the engine load taken by the twin rear wheel equipment, is good and the steering therefore light; space beside the driver, which with the front engine layout is wasted, is usefully employed for the entrance and stairs; finally, the engine is accessible for maintenance from the ground level, whereas when the power unit is at the front the mechanics generally have to clamber over the wings.

Front wheel drive, despite its relative complexity, has considerable advantages for light commercial vehicles. One is, of course, that the engine, transmission and front suspension can be mounted together as a single sub-assembly that can be readily applied to a wide range of different vehicles. But the greatest benefits accrue as a result of the low floor level obtainable behind the cab. It is not, perhaps, always realized that the obviation of a propeller shaft drive to the rear enables the structural efficiency of the chassis to be increased.

A noteworthy advance that has been made in response to the demand for engines of increased power output, is the application of turbochargers, in conjunction with Roots blowers, to two-stroke diesel engines; an alternative measure for four-stroke engines is to increase swept volume by the employment of thin-wall liners. It is of interest that the distributor type injection pump is now being employed on large diesel engines. There is also a trend towards the adoption of wax element type thermostats. At first sight, because these are slightly more expensive than the more widely used types, there might be a tendency to reject them; however, with this type of thermostat high pressures can be specified for cooling systems, and this leads to economies in respect of weight, space and cost of the radiator, which more than offset the increased cost of the thermostat.

Studies are being made of the desirability of employing a separately mounted auxiliary gearbox for driving accessories such as the fan, water pump, dynamo and compressor, particularly with underfloor engine installations. Not only would this arrangement give the designer a freer hand with regard to layout, but it can also facilitate access and maintenance. An incidental advantage is that the ball and roller bearings are better lubricated with the relatively clean oil in the gearbox than with engine lubricant contaminated with products of combustion. One wonders whether hydraulic drives, with their inherent flexibility with regard to speed control and layout, might be better than mechanical drives for auxiliaries.

So far as transmissions are concerned, the rear engine layout for double-deck buses is becoming popular. Although a drive line parallel to the longitudinal axis of the vehicle has advantages in respect of floor layout and transmission dynamics, the angular drive arrangement is perhaps less costly. For commercial vehicle gearboxes in general, if synchronization is desirable at all, it should be on all speeds, especially on vehicles for export to mountainous countries. The stepped dog synchronizing clutch arrangement, which has been introduced on a heavy commercial vehicle this year, has much to commend it. It would appear that, in view of the general trend towards higher cruising speeds, more attention might be paid to the lubrication of both gearboxes and axles.

Although air suspension seems to be gaining ground only for tankers and trailers, it appears inevitable that it will eventually be regarded as essential for coaches. Anyone who has experience of long journeys in vehicles so equipped will testify that the suspension can be better than that of private cars, and therefore such vehicles are in a good competitive position, especially relative to the railways. Non-reactive types of suspension for bogies are becoming more widely used.

Admittedly it is not often that brake systems fail completely, but when they do, the results are generally very serious. Obviously, therefore, the recently developed dual systems and those that give independent operation of the front and rear wheel brakes will be viewed with interest. There is a strong case for the employment of power assisted handbrakes, provided they remain adequate under manual operation should the power assistance fail. One of the advantages of the transmission type handbrake is that it eliminates the linkage to the rear wheels, and therefore reduces the amount of maintenance needed.

So far as safety is concerned, the use of the four headlamp system is welcome, and sealed beam lamps should give good service. Fluorescent interior lighting is not only more attractive but also reduces the loading on the electrical system. In the latter connection, it seems that in general the stage has been reached at which the a.c. rectified systems will have to be introduced. Other directions in which progress can be expected in the two years that will elapse before the next commercial vehicle show are towards the improvement of cab design in respect of driver comfort, the more widespread use of laminated plastics for construction and of plastics materials in trim.

COMMERCIAL VEHICLE EXHIBITION

Engines

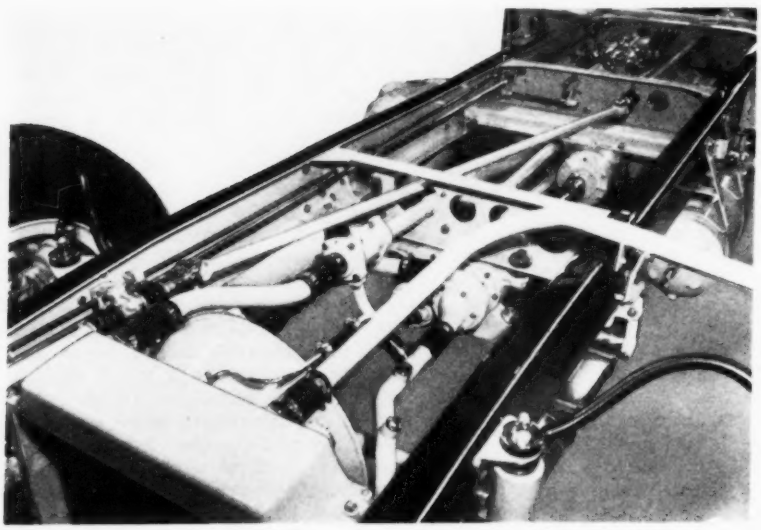
Further Progress with Small Diesel Engines, Distributor Type Injection Pumps Used on Larger Engines than Hitherto, and a Trend Towards Increasing Power Output

In the commercial vehicle show of 1960, there was no evidence of any major design tendencies so far as engines are concerned, but of course many details of great interest were to be seen. It would appear that the small diesel unit has made more progress against its rival, the petrol engine. Among the established diesel engined vehicles, the trend seems to be towards larger-capacity power units and better power: weight ratios. Perkins, Leyland, Gardner, A.E.C. and Bedford all offer engines of improved performance. The most creditable figures, however, must surely be those of Leyland Motors Ltd, who, on their 680 series engine, are able to offer, for road vehicles, a maximum b.m.e.p. of 122 lb/in^2, which is only dropped to 110 lb/in^2 when the engine is used for rail traction purposes.

The increased swept volume of several engines has been achieved by the use of Cromard cylinder liners. This type of liner has a wall thickness of only 0·040 in, a hard chromium plated, prefinished bore treated to give good oil retention properties and, at its upper end, a flange of the same thickness as the walls. In the case of the Perkins engines fitted with this liner, counterbores are machined in the top face of the cylinder block to take the liner flange, and the gasket seals between the liner and the cylinder head. The Leyland method of installing these liners is to seat the flanges on a plain top deck: thus, the machining of counterbores, to close tolerances, is obviated, and the head gasket seals outside the liner flange; the gasket thickness is such as to allow the flange of the liner to be nipped between the cylinder head and the top face of the block.

Several manufacturers prefer to employ dry liners with an interference fit, and to finish the liner bore in position in the engine. Both ceramic coating and chromium plating of the outside of wet cylinder liners are employed to combat the cavitation erosion frequently experienced with this type of liner. The employment of set bolts instead of studs—by Ford, for example, on their diesel engine, and others on petrol units—for securing the cylinder head, is claimed to reduce bore distortion considerably but does not yet appear to have attained the popularity that might have been expected. Bedford, however, have for many years taken their head studs down through the water jacket and anchored them in the lower deck of the cylinder block, adjacent to the main bearing studs.

Progress continues in respect of the power output of petrol engines, and several manufacturers offer alternative com-



Below the pierced cross member in the centre of this picture of the A.E.C. underfloor chassis is suspended the remotely mounted gearbox that drives the accessories

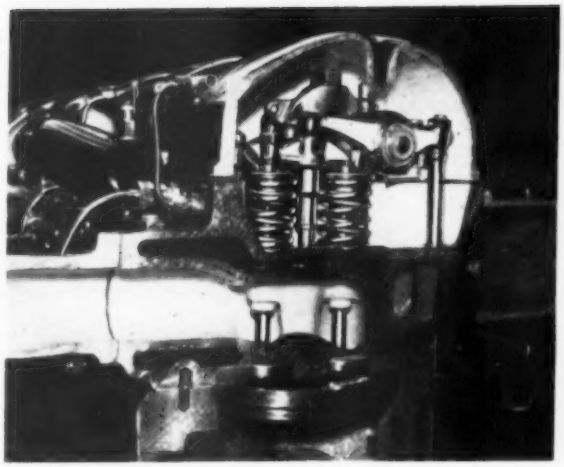
pression ratios. Some have argued in the past that the diminished power increase obtained as the compression ratio is raised beyond 7·0:1, renders high ratios unnecessary. On the other hand, high ratios can give a very real gain in economy during part-throttle operation. As engine peak speeds tend to increase, it is becoming apparent that, owing to the effect of falling volumetric efficiency on the compression pressures reached, substantial power gains could be made in many engines by increasing the compression ratio.

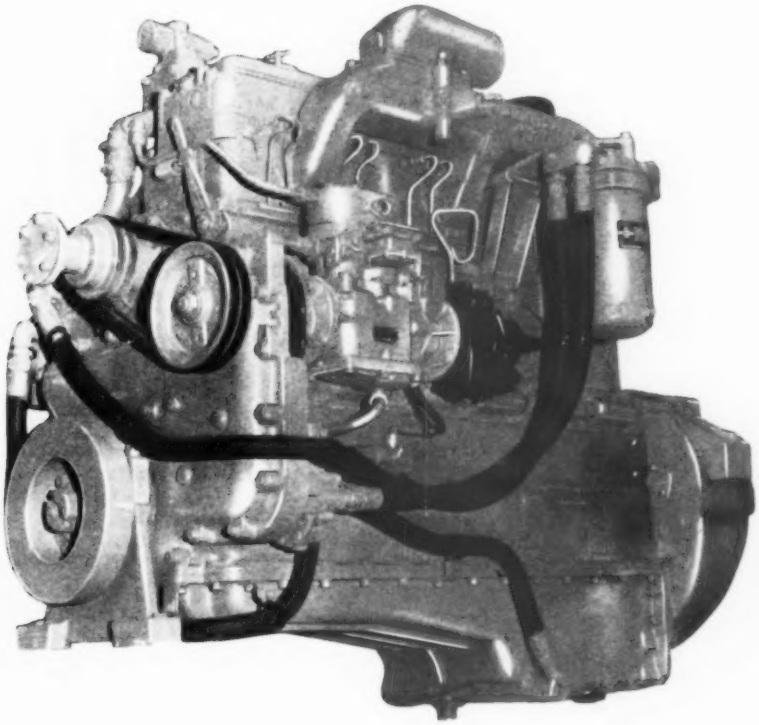
The automatic choke appears to be gaining ground: during the last few years its use has spread from the large American engines to those of some of our luxury car manufacturers and now to the smaller engines, some of which are used in commercial vehicles as well as cars. It is felt that this, and the warm air intake for winter use, will gain favour with both manufacturers and operators. The side valve petrol engine is not yet completely obsolete, since Scammell and Ford continue to make engines of this type.

Valve rotators or free valve systems do not appear to have made much progress in either petrol or diesel vehicles, Ford and Bedford being the largest manufacturers to use devices of this type in the search for good valve seat life in their diesel and petrol trucks. On the subject of valve gear life, it is worthy of comment that the valve clearance adjustment of two engines exhibited is carried out at the valve end of the rocker, necessitating the use of a spherical ended pad wiping, with point contact, on the end of the valve stem. Perkins, on the P6 engine, fit a pressed steel rocker of most ingenious design, which has hardened end pads pressed into position; in this instance, valve clearance adjustment is effected at the tops of the push rods. On the new Six 354, Perkins use exhaust valve material to specification 21-4N, with a Stellite tip on the end of the stem.

The first flush of enthusiasm for turbocharging appears to be over and its potentialities can now be assessed with greater clarity. Application of the turbo-blower has brought several problems, one of which would appear to be the maintenance of a good cylinder head gas seal under high internal pressures inherent with raised outputs. One application, however, that appears to have worked out very well is on the Foden Mk IV two-stroke engine. In this installation, the C.A.V. turbocharger feeds a Roots type blower, which, in turn, supplies the air chest surrounding the ported liners. Thornycroft and Leyland both exhibited large diesel engines equipped with turbochargers.

Multi-fuel engines continue to be a topic of conversation rather than to appear in fact. The Rootes and Foden two-stroke engines are known to respond quite well to the use of both petrol and diesel fuels; cold starting ability is the only feature affected to any extent by the type of fuel used. The 11·3 litre Thornycroft engine also appears to be suitable for the use of petrol as a fuel: presumably a helpful factor in this





Above: The A.E.C. 1100 engine has four valves per cylinder. This section of the head shows how two inlet valves are actuated by one push rod and a rocker that operates on a yoke piece. The yoke slides on the vertical spindle between the two valves

Left: This Cummins engine is now manufactured in Great Britain. An unusual feature is the employment of flexible pipes externally to take the lubricating oil to various parts of the engine: there are no internal pipes, which could fail in use

respect is its long stroke. In cold starting a compression-ignition engine on petrol, the fire risk would appear to be significant. Should one or more cylinders fail to fire, the fuel tends to cool the cylinder even further and unburnt fuel is pumped into the exhaust system, eventually igniting and causing violent backfiring.

One surprise of the show was the A.E.C. 11·3 litre direct injection engine fitted with a C.A.V. distributor type fuel injection pump. This is the first production application of this pump to an engine of such a size, and a very neat installation it makes. The distributor pump is equally neat and practical when mounted on the rear of an exhauster or compressor: a very good example of this is the installation on the Albion engine.

The Simms Mini-pump appears to have gained in popularity for engines in the medium capacity range: in most cases it is driven through a Simms rubber-in-compression coupling. Another noticeable feature was the use on many engines of the spring-steel disc type of coupling for fuel pumps, and on one engine exhibited, a rubber gaiter was fitted over the C.A.V. fuel pump coupling.

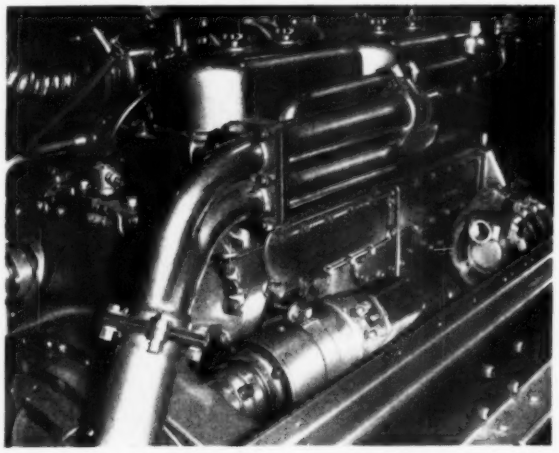
Thermostats having valves operated by wax type elements are now used on several engines. They appear to be of more robust construction than the bellows variety. Finally, a comment on the criterion of lb weight per lb-ft torque, quoted by Fodens Ltd. in some of their literature: this would seem to be a most interesting way of comparing engine performance, especially if it were slightly elaborated to include the weights of the cooling and exhaust systems.

A.E.C.

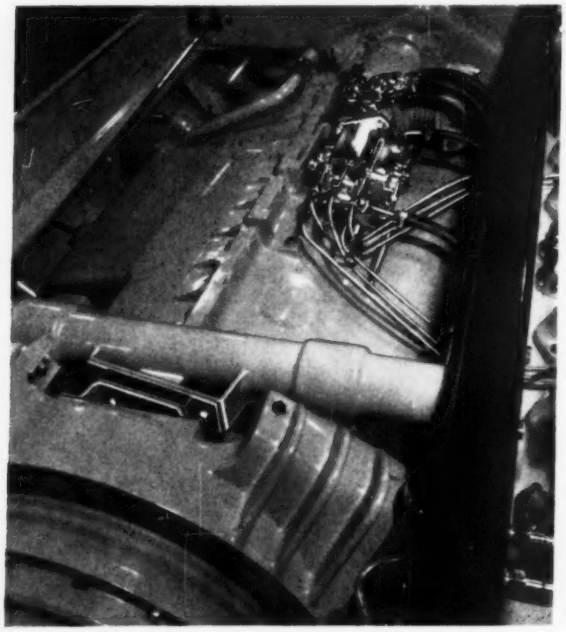
Four basic engines manufactured by A.E.C. were seen in various forms at the Show. Of primary interest was the AH 690, 11·3 litre horizontal engine, shown in an underfloor-engine chassis and fitted with the C.A.V. distributor type fuel pump. This pump has previously been used only for smaller engines, so its application to an engine of this size opens up a new field of development. On this underfloor installation, A.E.C. has tackled the problem of auxiliary drives in a novel way, providing a universal-jointed shaft drive from the front of the engine to a remotely mounted accessories gearbox. With this arrangement, removal of the engine from the chassis is relatively simple, because the water pump, fan and dynamo do not have to be disconnected. It is felt that an additional advantage accruing from this method is the isolation of the ball and roller races, commonly used to support accessory drive shafts, from the acidic content often present in the crankcase lubrication system.

In their wet liner arrangements, A.E.C. provide for top flange location of the liner and sealing of the lower end of the skirt by means of rubber O-rings in grooves in the cylinder block casting. To combat cavitation erosion, which has been experienced in recent years by many engine builders, the outsides of the liners of the 1100 series engines are chromium plated, whereas those of the smaller units have a ceramic coating.

The power outputs of the A.E.C. engines are extremely good: for the 11·3 litre, 690 unit, 168 b.h.p, at 2,000 r.p.m, and a maximum torque corresponding to a b.m.e.p. of 110 lb in^2 are quoted; the 470 series engine, of 7·685 litres, gives 112 b.h.p. at 2,000 r.p.m. with a maximum torque corresponding to 108 lb in^2 b.m.e.p. The well known 590 in^3 engine, 9·636 litres, has a power output of 128 b.h.p. at 1,800 r.p.m.



Above: This exhaust system was developed for use with a turbocharger on the Daimler engine. It has, however, led to an increase of 2 or 3 h.p. at the top end of the speed range of the normally aspirated version



Left: Distributor type fuel pumps are now being used on relatively large engines. This illustration shows the C.A.V. unit installed on the A.E.C. 11·3 litre underfloor engine. The illustration also shows clearly the arrangement of the rear mountings of this power unit

Another engine, manufactured by A.E.C. and shown by British United Traction Ltd, is the 1100 unit, intended for railcar and shunting locomotive use, and made in both horizontal and vertical forms. Its swept volume of 17·89 litres gives it excellent torque characteristics—773 lb-ft continuous rating—even when normally aspirated. It can, however, be supplied in turbocharged form, when the continuous maximum torque rating increases to 940 lb-ft, equivalent to 131 lb in^2 b.m.e.p. An intermittent rating, for automotive applications, allows a maximum b.m.e.p. of 164 lb in^2 in the case of the turbocharged engine, and 124 lb in^2 for the normally aspirated version. In addition to the normal oil pressure pump, the 1100 unit engine has a second pump circulating the sump oil through a twin element, oil-to-water

heat exchanger. Twin, axial type electric starters, operated by a special switch ensuring synchronous operation, are used to obtain a speed of rotation adequate for starting the unit.

Albion and Commer

Two four-cylinder engines and one six-cylinder unit were shown by Albion Motors Ltd. One of the four-cylinder units, of 5·5 litres swept volume, has a C.A.V. distributor type fuel injection pump, mounted on the rear of the exhauster. The other engines have Simms fuel injection equipment. A recent change is the use of a full-flow, paper element oil filter instead of the centrifugal by-pass type originally employed.

In addition to petrol engines of 1,390 cm^3 and 1,494 cm^3 swept volume, based on the Hillman Minx and Husky power units, Commer Cars Ltd. produce a four-cylinder 2,260 cm^3 diesel engine and their well known three-cylinder, opposed piston, two-stroke diesel unit. The petrol engines, with plain bath tub combustion chambers and iron heads, develop maximum b.m.e.p. of 131 lb/in^2 and 124 lb/in^2 for the smaller and larger versions respectively, both of which have a compression ratio of 7:1. The 2,260 cm^3 unit is notable for the use of the Ricardo Comet Mk V combustion system, together with the C.A.V. distributor type fuel pump. Maximum b.m.e.p. for this engine is 98 lb/in^2 at 1,500 r.p.m.

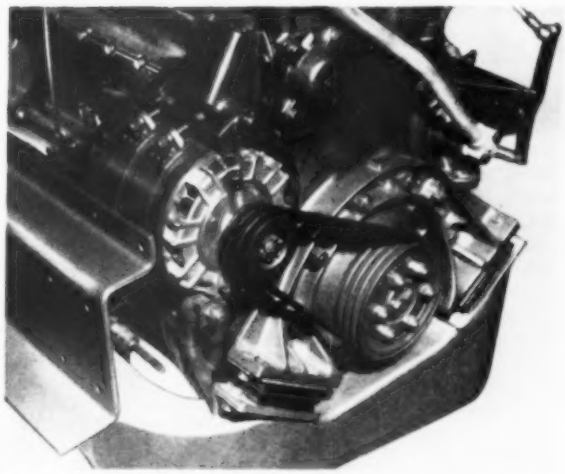
The Rootes two-stroke engine is of course well known and, in fact, has required very few changes during the past two years. Its fuel pump rack now has an adjustable setting arrangement so that fuels of various specific gravities can be used, and the fuel pump elements have a pressure oil feed from the main lubrication system. This latter feature has been found beneficial for prolonged high-speed operation because, since this is a two-stroke unit, the pump runs at the same speed of rotation as does the crankshaft of the engine.

Daimler

Development of the Daimler 8·6 litre engine has continued and this unit is now offered in Mk VIII form, giving 125 b.h.p. at 2,000 r.p.m. or, when turbocharged, 150 b.h.p. at 2,000 r.p.m. and 114 lb/in^2 b.m.e.p. Transversely mounted at the rear end of the Fleetline chassis, the engine has a dual type exhaust manifold. This was originally developed for turbocharged applications but it also gives a gain of 2 to 3 h.p. at the top end of the speed range on the normally aspirated engine. This is one of the engines mentioned earlier in which the liners are now bored in position for greater accuracy—the earlier engines had slip-fit liners. In a further effort to maintain a good cylinder bore shape, the water system has been modified to give both a front and a rear water feed to the cylinder block. All the piston rings—two of the compression type and one oil scraper ring to each piston—are chromium plated.

The main oil gallery is now cast and drilled in the cylinder block. This supersedes the previous arrangement, in which a steel oil gallery pipe was suspended between the main bearing caps, because cracking of the pipe was occasionally experienced. The Daimler Co. Ltd. has also increased the efficiency of the oil pump, particularly at low speeds, by attention to leakage paths, both at the ends of the gears and between the teeth. This has resulted in the idling oil pressure being increased to 35 lb/in^2; the running pressure is 45 to 55 lb/in^2. At the rear end of the crankshaft, a seal of piston ring type has been adopted instead of the scroll type previously fitted.

On this engine, the compression ratio remains at 14·85:1, but the swirl imparted to the incoming air has been increased by means of a lip on the inlet valve seat, thus promoting good combustion at low r.p.m. Although the crankcase and rocker covers are connected by pipes to the induction manifold, no air intake breather is provided to filter fresh air to the interior of the engine. The engine exhibited had a C.A.V. alternating current generator mounted on it; this component is driven from the front of the crankshaft, at just over twice engine speed, by three small section, cogged V-belts; belt tension is adjusted by a rack having approximately $\frac{1}{4}$ in pitch teeth.



A triple-belt drive is used for the C.A.V. a.c. generator on the 8·6 litre Daimler engine. The ratchet mechanism for tensioning the belts can just be seen immediately below the front end cover of the machine

Foden

Fodens Ltd, of Sandbach, in addition to using Gardner and Cummins engines, continue to manufacture their well known two-stroke diesel units. Introduced just after the war, the six-cylinder two-stroke model was rated at 126 b.h.p. at 2,000 r.p.m; in Mk III form it now produces 150 b.h.p. at 2,400 r.p.m, and the turbocharged Mk IV unit develops 210 b.h.p. at 2,200 r.p.m. The four-cylinder version has been similarly up-rated to 100 b.h.p, but no turbocharged version is yet available. The power gain has been chiefly due to the increase in operating r.p.m, no major changes having been made to the engine, apart from an oil pressure feed that has been found necessary to the fuel injection pump. An oil-to-water heat exchanger replaces the separate oil radiator.

As mentioned earlier in this review, the application of a turbocharger to the two-stroke cycle appears to give good results. Certainly the Foden engine, with its ring of cylinder liner to head securing bolts, giving a sound gas seal, is one engine in which one might expect these results to be obtained without difficulty. In turbocharging the six-cylinder engine, little has had to be changed. The Roots type feed blower has been replaced by the smaller unit from the four-cylinder engine; the cast aluminium exhaust manifolds normally used are replaced by cast iron pipes suitably shaped to take a double feed to the turbine—three cylinders exhaust into each pipe—and the fuel pump element size has been increased.

A modern idea from this old established concern is the use of a glass reinforced plastics pipe, moulded to suit the run and end connections, between the air cleaner and the blower entry. From the turbocharger to the Roots blower, the air is fed through an air-to-air intercooler—manufactured by the Coventry Radiator and Presswork Co. Ltd.—mounted in front of the main radiator. Turbocharging has increased the maximum torque from 365 to 550 lb-ft; the equivalent b.m.e.p. figures are 107·5 × 2 lb/in^2 and 165 × 2 lb/in^2 respectively. This last is a remarkable figure and reflects great credit on the Foden designers.

The necessity of preventing over-fuelling under accelerating conditions from low engine speeds has led to the development of a dashpot device for regulating the fuel pump rack opening: the rate of opening is dependent on the output pressure

of the turbocharger, very little or no rack opening delay being experienced once the blower pressure rises. The exhaust of the two-stroke engine is notoriously sensitive to back pressure and difficult to silence. It would appear, however, that the turbine forms a very effective form of silencer and will enable simplified exhaust systems to be used.

Ford and Gardner

The changes in the Ford engines are of a relatively minor nature and made in such a way that they do not affect interchangeability. A Reinz cylinder head gasket is now used for the four-cylinder engine, and the crankpin fillet radii have been increased. Optional compression ratios of 7·8:1 or 6·9:1 are offered on the 1,700 cm^3 petrol engine.

Norris, Henty and Gardners Ltd. continue to produce engines of superlative quality and unusual design conception. In the LX series engines, introduced two years ago, the whole crankcase structure is stiffened by transverse bolts in its lower half. This principle of adding stiffness to the crankcase has been used in many famous engines in the past. Four that come immediately to mind are the Ricardo designed Vauxhall TT unit, the Offenhauser, the pre-war Mercedes 1½ litre Grand Prix model and, in more recent years, the 2½ litre Coventry Climax racing engine. Perhaps, in view of the current interest in aluminium engines, this is a significant feature.

Goggomobil

Exhibited for the first time at the London Commercial Vehicle Show this year, the Goggomobil van has a very neat horizontally opposed air cooled petrol engine, of 688 cm^3 swept volume, known as the TK700 unit. This appealed to the author as being one of the most outstanding designs to be seen for some time. The engine is mounted as a unit with a gearbox having Porsche type synchromesh on all four forward ratios. It is claimed that the total weight of the engine and gearbox is 236 lb, and that the engine unit alone weighs 181 lb.

The main features of this unit can be seen in the accompanying illustration, but the crankcase breathing system is worthy of special mention. Owing to the fact that the two pistons move in opposite directions, the crankcase volume varies by the swept volume of the engine once per revolution. The designers have dealt with this by sealing the crankcase with a combined oil filler cap and dipstick, and taking small bore pipes from suitably baffled areas in the rocker boxes to the

Above: The Leyland 400-S Power-Plus diesel engine has an opposed-port cylinder head layout. Other design features of this unit can be seen from the view on the right

tract between the air cleaner and carburettor. Thus, there is a small depression in the crankcase for most of the engine cycle.

Cooling air is ducted over the cylinders from a crankshaft mounted fan; a separate fresh air duct from exhaust pipe cowls is used to supply warm air to the van interior. A starter-generator of 130 watt output is mounted on the front end of the crankshaft. The engine develops 30 b.h.p. at 4,900 r.p.m, and a maximum torque of 34 lb-ft—equivalent to 122 lb in^2 b.m.e.p—at 3,500 r.p.m. It has a single Solex downdraught carburettor, and the compression ratio is 7·2:1.

Klöckner-Humbolt-Deutz

Of great interest to any student of engine design are the Deutz air cooled diesel engines. There are two main ranges, based on two cylinder sizes—0·76 and 1·33 litres. The unit exhibited in the rear-engined coach was a six-cylinder V-type, of 8 litres swept volume, giving 125 b.h.p. at 2,300 r.p.m. Its maximum torque of 332 lb-ft corresponds to a b.m.e.p. of 87 lb in^2, and the net weight of the engine is 1,618 lb. The air cooled aluminium cylinder head has a cast-in combustion chamber, into which is screwed the injector and a heater plug. Above it, the rocker gear is housed in a separate casting. Long studs secure the cylinder head and the cast iron cylinder barrel to the crankcase.

Now that these engines are appearing in this country, not only in coaches but also in double-deck buses, it will be interesting to see what results are achieved. The Gosport and Fareham Omnibus Co. states that the units fitted in its Guy Arab Provincial double-deck buses give a fuel consumption practically that of the fleet average, and that the maintenance required is much less than on their other vehicles. Noise is not a problem at all.

Leyland

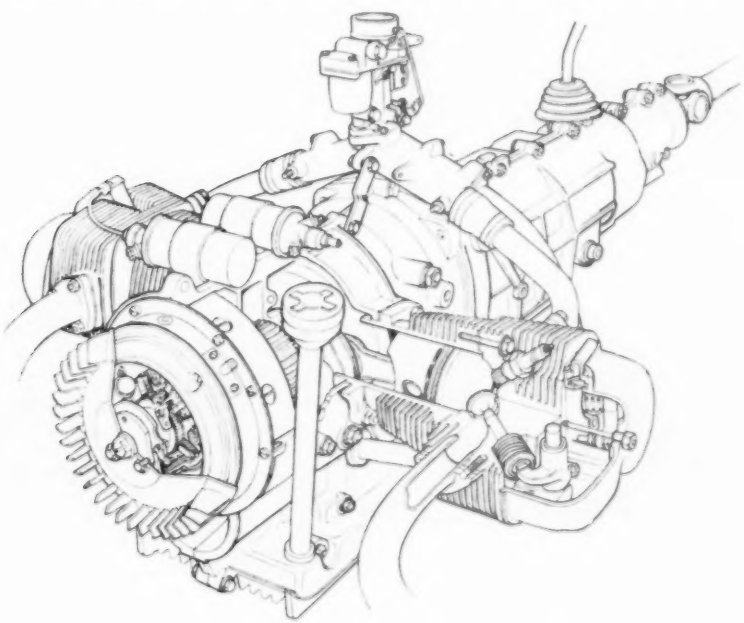
Designated the Power-Plus series, three new engines, of 400, 600 and 680 in^3—6·54, 9·8 and 11·1 litres—swept volume, have been introduced by Leyland Motors Ltd. These engines have very high output ratings: the 400 series, four-cylinder engine has a maximum torque of 300 lb-ft, equivalent to a b.m.e.p. of 113 lb in^2; although the 600 series six-cylinder unit is governed to 1,700 r.p.m, its maximum power is 140 b.h.p. at 98·5 lb in^2 b.m.e.p, and it develops its maximum torque of 438 lb-ft, equivalent to 110 lb in^2 b.m.e.p. at 1,200 r.p.m; finally, the 680 series engine develops no less than 200 b.h.p. at 2,200 r.p.m. and 106·5 b.m.e.p, and its maximum torque is 548 lb-ft at 1,200 r.p.m; this last figure corresponds to the very high b.m.e.p. of 122 lb in^2.

Each engine incorporates in its piston crowns the new spheroidal combustion chamber, the shape of which approximates in fact to a hemisphere with a raised pip in the geometric centre of its curved surface; this arrangement ensures that the maximum practicable quantity of air is carried past the extremes of the four fuel sprays. The dry cylinder liners of the 400 series engine are of the prefinished, thin-wall, steel type, manufactured by the Laystall Engineering Co. Ltd. They have a chromium plated bore and the top flange is formed from the tube. As has already been mentioned, this flange seats on the top of the cylinder block. Around it, the compressed asbestos fibre gasket is reinforced by a thin sheet steel ring. The liners of the 600 and 680 engines are of the normal prefinished, cast iron type with top flange location.

A difference between the 400 series engine and the other two is its opposed-port cylinder head arrangement: the exhausts are on the right of the engine, as viewed from the rear, and the cast aluminium inlet manifold is on the left, above the air compressor and Simms fuel pump. Further study of the design of the 400 engine reveals the use of the same size of main bearings as the 600 series, thus giving very generous bearing areas and overlap of crankpin and journal. The main journals are 3·5 in diameter and the crankpins 2·4 in diameter. A Metalastik unbonded type damper is mounted on the front end of the crankshaft; on the two larger engines, the dampers are of the bonded rubber type.

Paper element air cleaners are used in all three engines, each element having an effective area of 1,700 in^2: a double unit is employed for each of the larger engines, and a single one for the smaller engine. Provision is made for coupling the cleaners to a cold air pick-up or pre-cleaner. The air compressor inlet is coupled to the main air manifold down-

The Goggomobil 688 cm^3 engine develops 30 b.h.p. and weighs 181 lb without the gearbox. A dipstick is mounted on the readily accessible oil filler cap



Below: A piston from the Gardner LX series 150 b.h.p. engine. Only three rings are employed, and there is a very long land between the second compression ring and the oil control ring. The reliefs adjacent to the ends of the gudgeon pin bosses obviate all unnecessary contact between the piston and the bore of the liner

stream of the filters, and thus breathes clean air. All the engines have a wax element type thermostat for water temperature regulation.

Leyland Motors Ltd. also supply engines to British United Traction Ltd. for railcar and shunting locomotive use. These units are a modified version of the 680 series engine—for either vertical or horizontal mounting—and a larger engine of 926·6 in^3, or 15·2 litres, which again is made in vertical and horizontal forms. The bigger model can be supplied also in turbocharged form, in which its maximum power rating is 275 b.h.p. at 1,800 r.p.m, and its maximum torque 840 lb-ft, equivalent to 136 lb/in^2 b.m.e.p. For locomotive application, the 680 series engine has a rating of 160 b.h.p. at 2,100 r.p.m, and a maximum torque of 493 lb-ft; the equivalent b.m.e.p. figure is 110 lb/in^2.

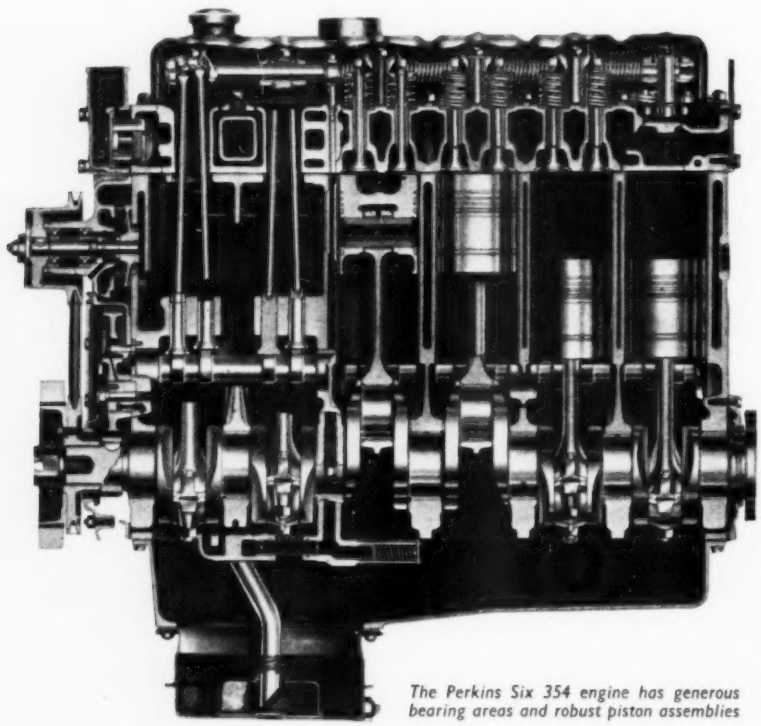
Mercedes-Benz

Making its first post-war appearance at the Earls Court Commercial Vehicle Show, Mercedes-Benz exhibited a four- and a six-cylinder diesel engine. The four-cylinder unit, of 1,780 cm^3 swept volume, has an output of 46 b.h.p. at 3,500 r.p.m, whereas the six-cylinder unit, of 5·1 litres, gives 110 b.h.p. at 3,000 r.p.m. Both engines have a pre-chamber combustion system and are of the conventional water cooled layout. The larger engine has provision for an exhaust brake, which is so arranged that it is automatically released should either the clutch or accelerator be depressed.

Perkins and Rover

A new direct injection six-cylinder 5·8 litre engine has been introduced by F. Perkins Ltd. Rated at 112 b.h.p. at 2,800 r.p.m. and weighing only 854 lb, this should become a very popular engine, particularly in view of the inherent economy of the direct injection system. The new unit is equipped with a C.A.V. distributor type fuel pump, which has an automatic advance and retard device in addition to the hydraulic governor. By virtue of this arrangement, the pump output and the injection timing are closely matched to the needs of the engine, thus giving prospects of extremely good fuel economy.

The Rover Co. Ltd. exhibited its four-cylinder petrol and diesel engines, of 2,286 cm^3 and 2,052 cm^3 swept volume respectively. Both, of course, are of the same basic design, and little change has been made to them since they were last exhibited. The aluminium cover of the timing gear has been replaced by one of the cast iron, in the interest of corrosion resistance. Since the latest heater plugs in the Ricardo Comet Mk V combustion chamber have a warm-up time of only 10 sec, their current consumption is appreciably less than that of the earlier plugs, which had a 30 sec warm-up time. Another new feature is the employment of the latest C.A.V. fuel filter, on which there is no separate canister for the element. It is worthy of note that this filter is mounted on the bulkhead—instead of on the engine—where it is not only accessible, but also is relatively free from vibration.



The Perkins Six 354 engine has generous bearing areas and robust piston assemblies

Scammell and Thornycroft

Mentioned earlier as being one of only two side valve engines at the Show, the 2,090 cm^3 unit produced by Scammell Lorries Ltd, with its square bore and stroke dimensions of $3\frac{7}{16}$ in, remains virtually unchanged. An unusual feature of this unit is the lubrication system. There is a side-mounted sump, into which the oil is scavenged from the crankcase by one element of a Hobourn-Eaton dual pump; the other element is used for supplying the lubricating oil to the engine. This pump, incidentally, is a very simple assembly for any manufacturer requiring either duplicated pressure or scavenge pumps, or a combined pressure and scavenge unit.

The 11·33 litre Thornycroft engine was again shown in turbocharged form. As was mentioned earlier, this long-stroke unit has proved eminently suitable for multi-fuel operation, in either this or the normally aspirated form. A power output of 230 b.h.p. at 1,900 r.p.m. can be obtained from the turbocharged engine when operating on either MT 80 petrol or diesel fuel.

Vauxhall

Pride of place in the Bedford range surely goes to the new 300 series engine, made in both petrol and diesel forms. The diesel version is of the direct injection layout and produces 97 b.h.p. at 2,800 r.p.m; on the other hand, the petrol unit, with a compression ratio of 6·6 : 1, gives 133 b.h.p. at 3,200 r.p.m. Comparison of their net torques reveals the diesel to be very little behind the petrol engine; the figures quoted are 225 and 212 lb-ft for the petrol and diesel versions respectively. These torques are equivalent to 113 and 107 lb/in^2 b.m.e.p.

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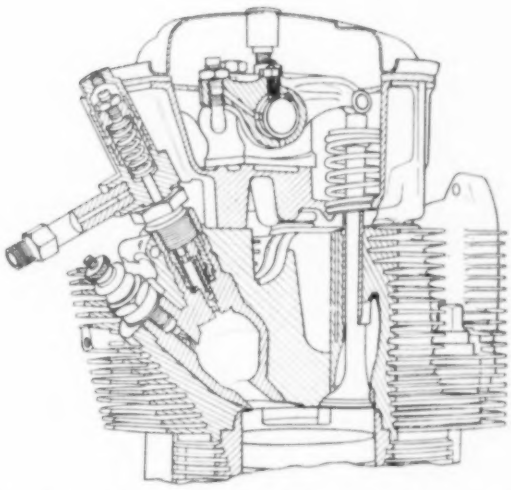
Analysis of the output figures quoted for the smaller petrol engines, for which alternative compression ratios are available, discloses some interesting evidence concerning the effects of the compression ratio on the maximum torque. The increase from 6·8 : 1 to 7·8: 1 on the 1,508 cm^3 engine raises the maximum net torque from 76 lb-ft to 78 lb-ft—124·5 to 128 lb/in^2 b.m.e.p—and the maximum gross torque and b.m.e.p from 82 lb-ft to 86 lb-ft and 135 to 141 lb/in^2 respectively. Similarly, a change in the compression ratio of the six-cylinder unit from 7·0 : 1 to 8·0 : 1 increases the net torque from 132 lb-ft to 138 lb-ft, and the gross torque from 142 lb-ft to 146 lb-ft. The corresponding increases in the net and gross b.m.e.p. are from 123 to 128·5 lb/in^2, and from 132·5 to 136 lb/in^2.



A sectioned, air cooled cylinder head of the Magirus Deutz diesel engine. The steel combustion chamber is cast in the aluminium head

Volkswagen

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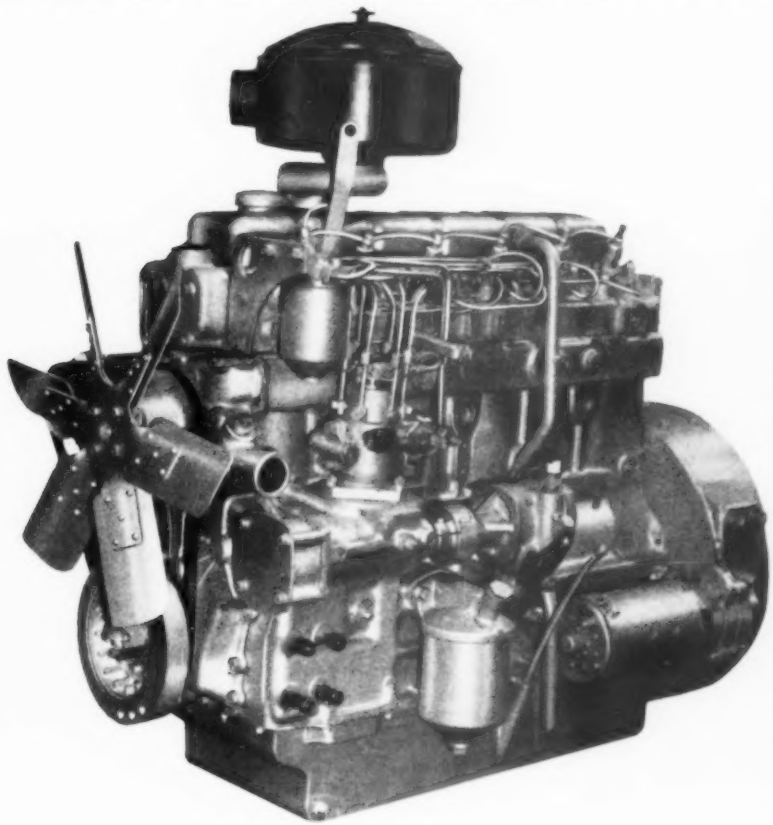
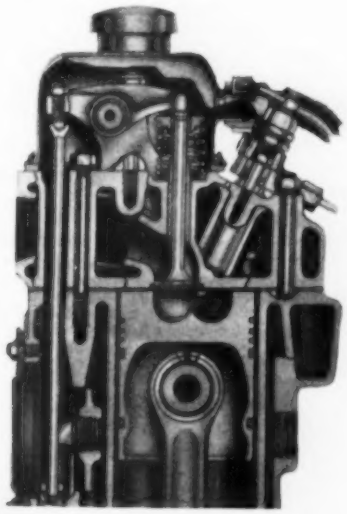
Among the modifications to the cylinder heads is the repositioning of the larger diameter valves, to give a wedge shape combustion chamber and a degree of squish. In addition the compression ratio has been raised from 6·6 : 1 to 7·0 : 1. Since it is recommended that the vehicle be run on petrol having a Research Method octane number of 90, the requirement is therefore for a fuel of slightly higher rating than that of our commercial grades. The modifications





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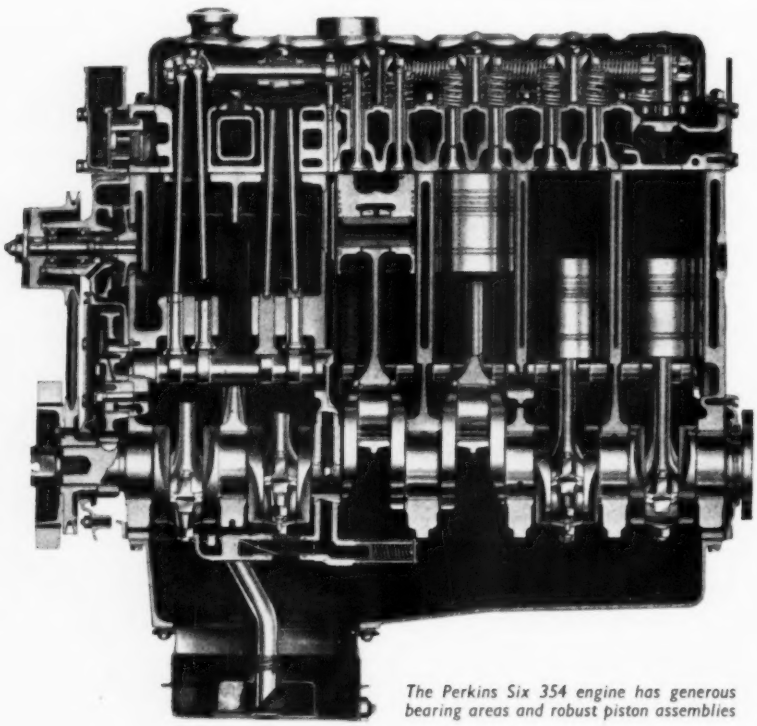

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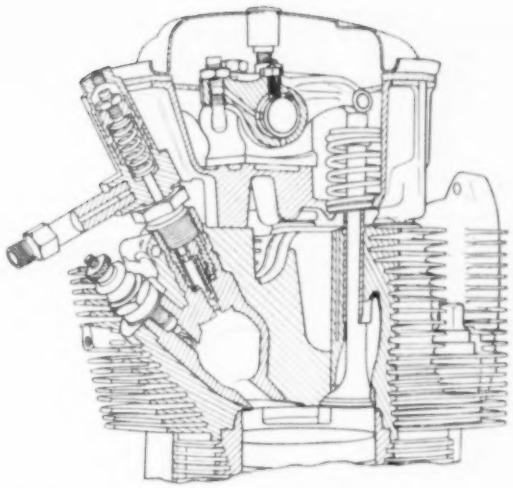

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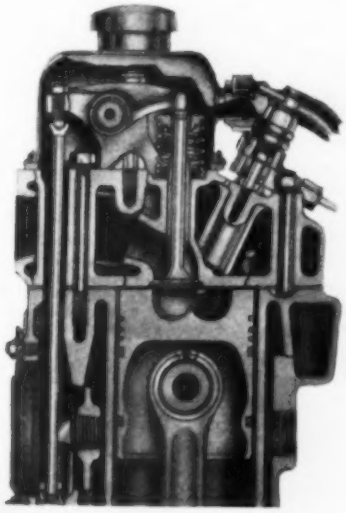

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mentioned, and others affecting the valve timing and lift, have resulted in an increase in the net power output from 30 b.h.p. at 3,700 r.p.m. to 34 b.h.p. at 3,900 r.p.m; at this speed the b.m.e.p. is 103 lb/in^2, which is still not a very high figure for an 1,192 cm^3 engine. The maximum torque and b.m.e.p. are 61 lb-ft and 127 lb/in^2, at 2,000 r.p.m.

Another intriguing feature of this engine is an oil feed to the bores of the mushroom type tappets, whence the lubricant passes through the hollow pushrods to the rocker gear. For cold starting, the Solex carburettor now has a choke controlled by a bimetal strip, which closes the butterfly valve at low temperatures. Warm-up of this strip, and the consequent opening of the butterfly, is accelerated by a small electric heater element coupled to the ignition switch. An over-riding automatic control allows the butterfly valve to open also at higher engine speeds or under overrun conditions.

A flap valve in the engine air intake enables warm air to be fed to the air cleaner, but only at low intake velocities: it opens automatically at high speeds, and allows fresh cool air to be inhaled. The flow of cooling air to the cylinders and heads is thermostatically controlled. Automatic control of the ignition timing is now effected only by a vacuum device, the centrifugal control having been eliminated in the latest engines. All these changes have been made with a view to achieving the maximum possible economy of operation, since, in comparison with a water cooled engine, the air cooled unit is at a disadvantage in respect of maximum useful compression ratio and part-throttle economy.

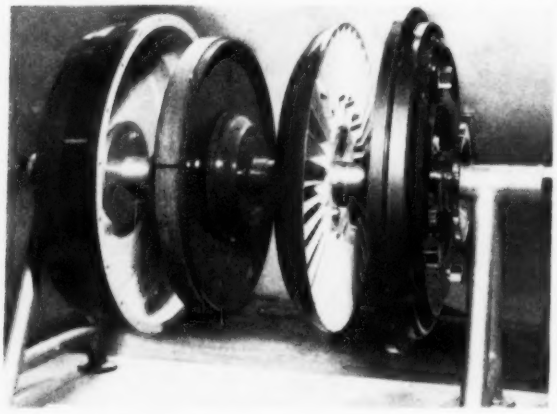
CLUTCHES

Latest Developments Include a Promising New Friction Clutch, Two Automatic Systems, and an Effective Means of Cooling a Clutch Assembly

IT has been announced that Laycock Engineering Ltd. is to manufacture the Laycock-Hausermann single-plate clutch, which was exhibited at Earls Court. The general conception of this clutch is to be commended because of its delightful simplicity and undoubtedly low production cost. Apart from the more or less conventional cushion type driven plate, the clutch consists of only six other members, namely the thrust plate, two relatively uncomplicated pressings, a diaphragm type spring, a snap ring and a release sleeve.

The diaphragm spring of this unusual clutch is held between the inner ends of the main pressings, and its periphery fits into a counterbore in the thrust plate, where it is retained between the end face of the counterbore and the snap ring in a machined groove. Thus the natural bias of the diaphragm spring forces the thrust plate against the driven plate. To avoid the danger of fracture owing to stress concentrations, the central portion of the diaphragm spring is divided into numerous segments, by radial slots terminating in holes. These segments engage directly in corresponding slots in the thrust sleeve. This simple arrangement obviates the necessity for separate release levers and their mountings and anti-rattle devices. Since it also eliminates the numerous deep pockets for the location and housing of the springs, as are used on conventional clutches, it results in simplification of the design and manufacture of the clutch outer cover pressing.

Automatic centrifugal clutch manufactured by Self-Changing Gears Ltd. A garter type coil spring round the hub of the shoe assembly retracts the shoes as the speed of rotation, and therefore the centrifugal force, decreases. To accommodate the clutch, the length of the fluid coupling is less than normal, and this gives a smooth take-up from rest



No extravagant claims are made for this clutch by the manufacturers. They simply point out four distinguishing characteristics, namely:

(1) Only light pedal pressure is required to release the clutch and hold it in the disengaged position
(2) The characteristics of the diaphragm spring ensure that there is no reduction in torque transmitting capacity throughout the normal life of the driven plate
(3) There is the minimum number of working parts
(4) Balance is maintained under all running conditions.

It would appear that the Laycock-Hausermann clutch should offer a weight advantage, and its basic design should make it eminently suitable for the high speeds of the latest designs of internal combustion engines. In keeping with the tradition of Laycock Engineering Ltd, this meritorious design has undoubtedly been developed to a high degree of reliability, and it will be interesting to observe how rapidly the clutch establishes itself.

The Borg and Beck Co. Ltd, of Leamington Spa, which undoubtedly supplies the majority of clutches to the British automobile industry, has extended the range of A.S. type strap-drive clutches, and now produces them in diameters from 8 in to 17 in, for a torque range of 88 to 750 lb-ft. The basic design of these clutches is, of course, not new but it seems opportune to reiterate briefly that the straps transmit the drive from the cover to the pressure plate. For this purpose, one end of each strap is riveted to the cover plate and the other end is bolted to the thrust plate. It is claimed that parasitic friction losses, and rattles and squeaks while the clutch is engaged, are thereby eliminated, since the straps prevent rubbing contact between cover and pressure plate. Furthermore, balance is maintained over the fullest possible movement of the clutch release levers.

One of the surprises of the Commercial Motor Show was the Autoclutch system for commercial vehicles, which Borg and Beck exhibited for the first time. Although it might be thought that the Autoclutch was developed under the shadow of the Manumatic design introduced several years ago, there is no foundation for this suspicion. Without doubt, the experience gained with the Manumatic system has proved valuable during the development of the Autoclutch but the earlier unit has certainly not formed the basis of the new one.

Before describing the details of the Autoclutch layout, it may be of value to consider some of its features:

(1) The Autoclutch system can easily be fitted to any orthodox vehicle, irrespective of whether it is equipped with a diesel or a petrol engine
(2) It provides an automatic gear-lock for tow-starting
(3) Engine power and transmission efficiency are in no way adversely affected by this system
(4) Incorporation of the system will not have any adverse effect on fuel consumption
(5) It affords the most economical form of two-pedal control
(6) Its use greatly reduces driver fatigue in city traffic as well as on long journeys.

As the name implies, the Autoclutch layout was developed in order to provide a fully automatic clutch control system, and thus to simplify the whole driving technique. The system may therefore be fitted to any transmission arrangement in which a conventional friction clutch and a synchromesh gearbox are employed. It is intended primarily for commercial vehicles with a vacuum or compressed air system to which the diaphragm type clutch servo piston may be connected.

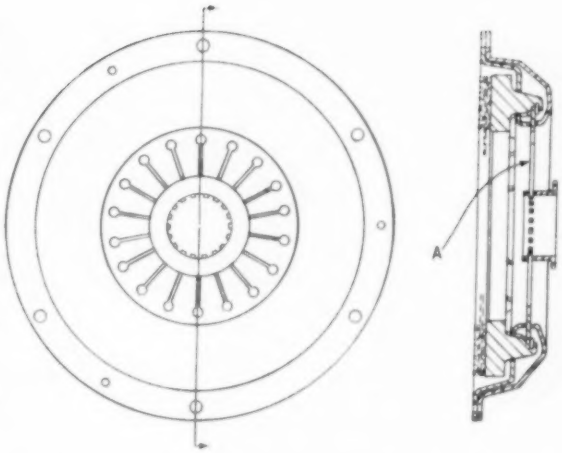
Basically the Autoclutch arrangement consists of five units and a modified gear-change lever. These units comprise a diaphragm servo piston, for clutch control, a governor control valve, a control unit that includes a solenoid valve, a switch sensitive to road speed, and a vacuum or air pressure reservoir if none is already provided on the vehicle. The governor control valve, which is connected to the air or vacuum system, incorporates a bob-weight type centrifugal governor. This governor can be driven by the fan belt or from a separate crankshaft pulley, whichever is more convenient for the particular installation.

The governor control valve, which is sensitive to engine speed as well as load, disengages the clutch when the vehicle is at rest. When the vehicle is in motion, a second valve, within the gear-change lever, controls the clutch. This valve opens when the knob is gripped, so that the air servo piston disengages the clutch but as soon as the hand is removed from the knob, re-engagement is once more under the control of the governor valve.

This control system, fitted in conjunction with an orthodox clutch, is preferable to that incorporating a centrifugal clutch, since it prevents abuse: there is no possibility of the driver's starting in the top or third gears of a four-speed box, which could result in burning out of the clutch. In the Autoclutch system, clutch disengagement in the higher ratios cannot take place unless the throttle is completely released or the gear-change lever is gripped. The solenoid valve in the control unit permits declutching in first, second and reverse gears only. In third and top gears, the switch sensitive to road speed de-energizes the solenoid below about 10 m.p.h., and thus causes the clutch to remain engaged.

Since this arrangement prevents an increase of road speed relative to engine speed, it avoids shock loading of the transmission on clutch re-engagement. Furthermore, it permits tow-starting and provides a convenient parking lock. The units comprising this two-pedal system can be employed with any size of engine and transmission; however, the diaphragm piston must be selected in relation to the work it must do in freeing and re-engaging the particular clutch, to ensure its complete reliability.

Self-Changing Gears Ltd, of Coventry, have produced what is called the Fluid Friction Clutch, in which a hydraulic coupling is combined with an automatic, centrifugal, friction clutch, for use with a Wilson type gearbox. The aim in this design is at overcoming the known shortcomings of both types of unit when employed singly. A fluid coupling ensures a smooth take-up from rest, but the small amount of slip—2 to 3 per cent—that occurs, even at high engine speeds, has a detrimental effect upon fuel consumption. Centrifugal clutches, on the other hand, eliminate slip at high rotational speeds but, in many instances, they show a tendency to jerk and judder during the initial engagement period. Furthermore, the disengagement of these clutches is often by no means as rapid as is desirable, since spragging effects cannot be readily eliminated under the widely varying operating conditions of road vehicles.



Laycock-Hausermann clutch: the commendable feature of this unit is its simplicity, which is obtained by the use of a diaphragm spring **A**

This new design solves the problem in an ingenious manner, and it is remarkable that the combined units occupy no more space than is required by a fluid coupling for the same duty. Space for the centrifugal clutch has been gained by reducing the axial length of the fluid coupling. To provide anchor points for the four shoes of the centrifugal clutch, the runner hub of the coupling has been extended and given a dished shape.

The periphery of each shoe carries a strip of friction material, in the manner of a conventional brake shoe. Two pivot holes are provided, so that the clutch may be assembled to provide the engagement characteristics of either trailing or leading shoe arrangements, as may be appropriate. A garter type coil spring applies the disengaging force to the shoes; when centrifugal force, owing to the increase of speed, overcomes the tension in this spring, the shoes move outward to contact the drive casing.

In shortening the axial length of the fluid coupling, to accommodate the clutch, the fluid volume contained in the coupling was deliberately sacrificed and so for any given speed, the rate of transfer of kinetic energy is reduced. The results are a desirable reduction in the drag at idling speed, and a limitation of the maximum torque transmission capacity. This apparent deficiency at high speed is compensated by the centrifugal clutch, which also obviates the slip mentioned earlier. Because the friction clutch shoes are mounted on the output member of the coupling, tow-starting is practicable. It is of interest that the Fluid Friction Clutch is finding increasing application in the industrial field as well as the automotive sphere, for which it was primarily developed.

Unorthodox, but apparently effective, is the clutch cooling arrangement developed by Dennis Bros. Ltd, of Guildford, in collaboration with the Borg and Beck Co. Ltd. Simplicity is the keynote of this design, the only departure from standard being that the bell housing embodies a cast-in diaphragm partition and suitable apertures for the admission and ejection of air. A 16 in diameter single-dry-plate clutch is assembled,

in the usual manner, on the flywheel with its starter ring gear. The diaphragm partition, which is positioned in the region of the ball type thrust bearing, is slightly dished towards the clutch and has a central hole about 2 in larger than the outside diameter of the thrust bearing.

Between the diaphragm and the clutch assembly are clearances that are adequate, but which are certainly less than those in a conventional bell housing. The rotation of the clutch assembly centrifuges the air in the leading chamber and causes it to be ejected through holes cast in the bottom of the bell housing. This extractor fan effect results in air being drawn into the rear chamber through another set of holes near the bottom, and this air is directed, through the hole in the partition, towards the clutch centre. In its passage through the rear chamber, the air assists the cooling of the gearbox.

This advanced feature may easily have escaped notice on the Dennis Pax IV chassis at Earls Court, since in outward appearance the bell housing is little different from any other. Dennis Bros. Ltd. designed this ingenious cooling arrangement to cater for an input torque of 500 lb-ft, and employ it in conjunction with their rationalized four- and five-speed gearboxes. There is no doubt that it should provide improved clutch performance in conditions of congested traffic.

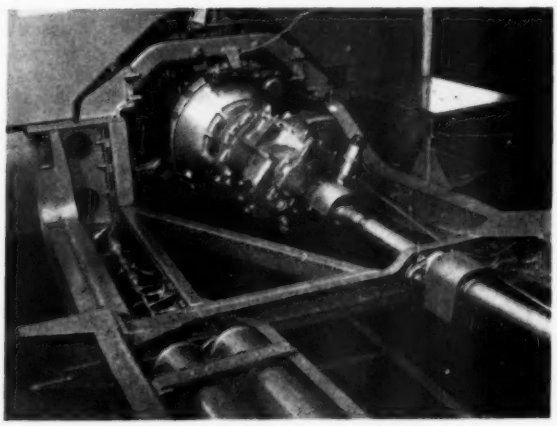
Transmissions

Several Entirely New Gearboxes Reveal a Trend Towards More Ratios and a Desire for Easier Gear Changing; an Automatic Transmission System Goes into Production

THE recent introduction of a number of novel chassis arrangements has demanded a reappraisal of layout in respect of the disposition of major units. It is not so many years ago that chassis arrangement for commercial vehicles was basically the same as that of private cars, but subsequently it seemed that the functional requirements in respect of passenger or cargo space had begun to over-ride those mechanical considerations that ensure the efficiency and reliability of the design. Now it would appear that a more balanced outlook has come into being, as a result of which it was possible at the commercial vehicle exhibition to make some interesting comparisons.

A good example of current thought is the A.E.C. Regal underfloor-engine, single-deck bus chassis. This vehicle incorporates a successful and well proved design principle, and earlier fears of operating difficulties because of dust and dirt have fortunately proved unfounded. The Wulfrunian chassis produced by Guy Motors Ltd. is another interesting design in which the conflicting demands of adequate space for passengers and for the disposition of engine and transmission units have been satisfactorily correlated. One of the most brilliant conceptions at Earls Court was the Daimler Fleetline 78-seat bus chassis; this vehicle has a transversely mounted power and transmission unit, the layout of which would, in some respects, seem superior to those of its competitors. Where front wheel drive is involved, it would be difficult to imagine a cleaner layout than those of the light vans presented by Dennis Bros. Ltd. and also Renault Ltd.

A very interesting transmission arrangement has been evolved by Dennis Bros. for the van just mentioned, which is a 30 cwt vehicle known as the Vendor. This system bears more than a fleeting resemblance to that employed on a current racing car, a fact that in no way detracts from the technical merit of the design. The gearbox provides three forward ratios and forms a unit with the final-drive, although this last-mentioned assembly has a separate front cover in the form of a bell housing.



Above: A fully ventilated clutch, mentioned at the top of this page, is used in conjunction with an all-indirect gearbox on the Dennis Pax IV chassis

Left: The Thornycroft transfer box and front wheel drive sub-assembly, with its manual control. Reverse gear for power take-off is a recent development that has added greatly to the versatility of the design

Ignoring its reverse gear, one can describe this gearbox—referred to as 3GD1— as of the two-shaft design, in which all the pinions are carried on an extension of the clutch shaft, while the gears are mounted on the shank of the spiral bevel pinion of the final-drive unit. The input shaft passes above the differential unit, close to the crown wheel, and is located by a deep-groove ball bearing at the end nearest to the engine; at its other end, the shaft is carried in a roller bearing, the outer race of which has only one lip. On the shaft, 14 teeth are cut for first and reverse gears, and pinions having 23 and 33 teeth are simply keyed to the shaft in front of the first gear pinion.

All the gears, including reverse, are in constant mesh and are engaged by spur type dog teeth. Since engagement of the three forward ratios is facilitated by Porsche type synchronizing rings, this gearbox is the first commercial vehicle unit with a synchronized first gear to be made in this country.

It appears that the gears idle on hardened steel centres, two of which are splined to the bevel pinion shaft; they have flanges in the form of three-arm spiders, and the muff couplings slide on them into engagement with one or other of the gears, to transmit power from the input shaft to the bevel pinion shaft.

Only two features of this interesting unit seem to be not entirely in keeping with the rest of this advanced design. In the first place, bottom gear, which might well be used to a considerable extent, is mounted next to second gear, rather than adjacent to the roller bearings at the rear ends of the shafts. The other feature is the lubrication of the gear bushes, in the traditional manner, through radial holes; though this method is by no means ideal it must be admitted that it seems fairly satisfactory in practice.

Salisbury Transmissions Ltd., who supply the final-drive and differential unit, should be given due credit for the bearing arrangement of the spiral bevel pinion: there are two opposed taper roller bearings immediately behind the pinion head-shims for positioning the inner race, and a parallel roller bearing at the rear end of the shaft. As this overall design stands, it should prove very satisfactory, although assembly of the gears and shafts has to be carried out within the narrow confines of the casing. The direct-acting gear-change lever, mounted in the gearbox cover, should ensure easy and foolproof operation.

The long established firm of Transport Equipment (Thornycroft) Ltd. exhibited two interesting transmission units of which the constant-mesh five-speed gearbox is as new as the prototype dumper chassis to which it was fitted. As a result of many years' experience with a differential lock in which the stepped dog principle is employed for easy engagement, this company has now produced a gearbox in which all the dog clutches are of this type. It may be recalled that this expedient has long been a feature of the American Fuller transmissions, and more recently has proved satisfactory on Lotus gearboxes fitted to formula racing cars. In fact, this year's motor racing World Championship was won by a Cooper car with similarly stepped dog teeth.

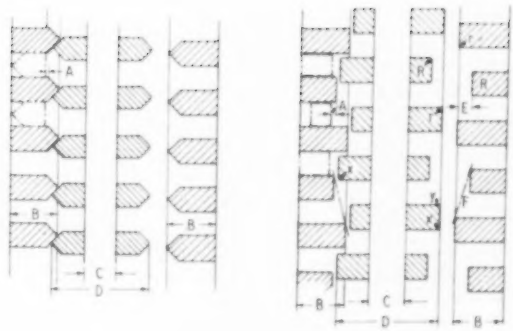
An even number of dog teeth is necessary, since the axial length of every alternate tooth of the coupling sleeve and its respective gear is shortened by about $\frac{1}{16}$ in; consequently, the dogs on each member appear to be staggered by this distance. During the engagement process, when the sleeve is moved towards the gear, it is possible for the longer teeth of sleeve and gear to meet, and engagement cannot take place until the differential rotation of the components ends this contact. At that moment, it is theoretically possible for the two sets of dogs to slide into complete engagement, but only if the driver is adept and the gear-change linkage is in absolutely first class working order.

If immediate engagement does not occur, however, the differential rotation can continue for a whole pitch interval of the dogs, during which period the coupling sleeve has to be moved axially only the distance of the stagger before the flanks of the long teeth meet, whereupon engagement can easily be completed. Admittedly almost one pitch interval is available during the engagement of conventionally chamfered dog teeth, but in the most likely case of contact between the opposing chamfers of the coupling and gear dogs, a considerable axial resistance has to be overcome before full engagement is possible. Dog couplings with staggered or stepped teeth are, therefore, easier to engage than those having the normal chamfered teeth; moreover they are less fragile and prone to wear than are those with pointed teeth. Manufacture of this type of dog tooth is not particularly difficult or expensive, since it can be done on a Hey's gear tooth rounding machine.

Another feature of this gearbox is a separate input shaft, an extension of which can be engaged to provide a straight-through, direct power take-off. When the gears are not engaged, they idle on hardened and phosphate treated steel bushes, instead of on the more usual rollers, needle rollers or bronze bushes. The third-motion or output shaft is conveniently placed both for a conventional drive to the rear wheels and for front wheel drive. In accordance with previous Thornycroft practice, engagement of the front wheel drive is effected pneumatically, and disengagement is assisted by spring pressure.

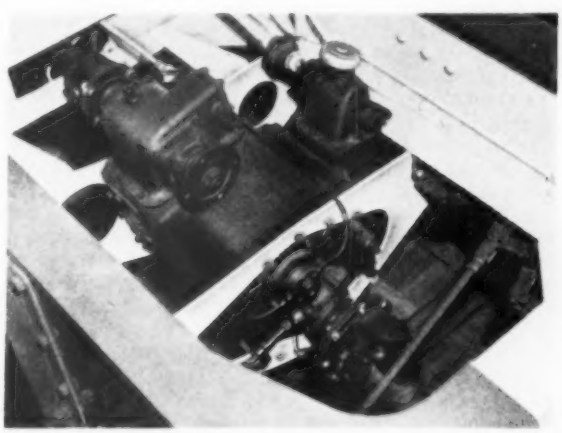
The other Thornycroft transmission unit mentioned is a three-speed auxiliary gearbox. Since it is designed for a gross train weight of 60 tons, 625 lb-ft maximum engine torque and a first gear ratio possibly as low as 6·07:1—with 10:1 in reverse—it is not surprising that it weighs over 6 cwt. The impression that this auxiliary gearbox is of conventional and simple design is reinforced by the observation that straight-tooth spur gears, all of which are finish ground, are employed. There is ample evidence, too, of careful attention to detail.

Customers for the type of heavy vehicle concerned often have special requirements: they may, for instance, desire to fit a crane, winch, pump, compressor or other addition which depends upon the vehicle engine for its actuating power. A versatile auxiliary or transfer gearbox is therefore essential if



A *depth of engagement preventing involuntary disengagement;* **B** *length of dog teeth of gear;* **C** *undercut deeper than dog teeth;* **D** *coupling sleeve;* **E** *approximately* $\frac{1}{16}$ *in difference in lengths of dog teeth for 10 D.P.;* **F** *engagement path of corner X*

In the Thornycroft five-speed gearbox illustrated below, the full power take-off is virtually a continuation of the input shaft. Another feature of this gearbox is the staggered dog type clutches for engagement of the gears after synchronization. From the left-hand of the two diagrams above, it can be seen that considerable axial force may be required to engage chamfered dog teeth. The right-hand diagram shows the staggered tooth arrangement: as soon as corner X slips off the end face of a long tooth it rotates and moves freely about $\frac{1}{16}$ *in axially until the face Y contacts the flank of the next long tooth, when engagement can be completed against the relatively light friction between the sets of dogs*



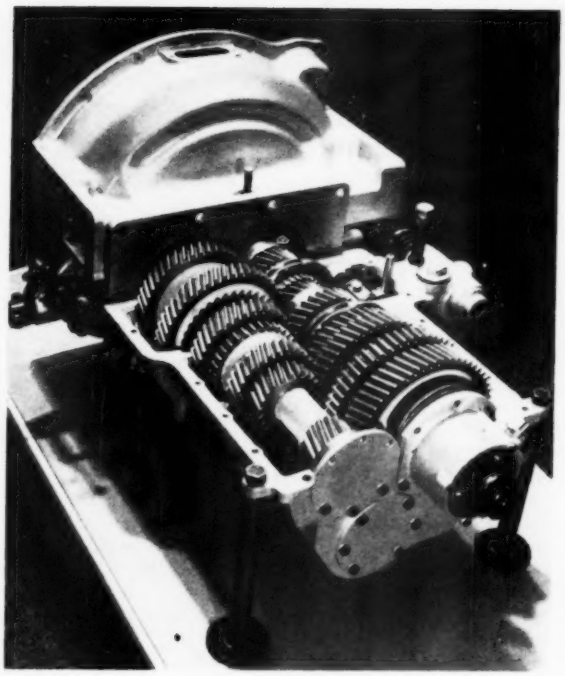
numerous expensive modifications—with the consequent wastage of valuable time—are to be avoided. The Thornycroft unit has been designed to meet the exigencies of varying requirements such as those just mentioned. For example, no additional parts are required if the power take-off is to be at the rear end of the box instead of the front; similarly, if front wheel drive is desired, the front cover of the output shaft is replaced by a complete front wheel drive sub-assembly, without any need for modification of the basic unit. Even the pneumatic control of the front wheel drive is part of the sub-assembly. Although this gearbox was designed for versatility, however, two additions or alterations have been found necessary, namely, a single-shaft selector mechanism for a forward control chassis layout, and a reverse gear for the power take-off.

All the gears are of the constant mesh arrangement, and are engaged by spur type dog clutches. They rotate on standard roller bearings mounted on amply proportioned shafts. Oil thrown up by the dipping gears is caught by sloping ribs on the casing and guided into the end cover, from which it is fed into the hollow shafts. Small radial holes in the shafts admit oil between the rollers, which are therefore effectively lubricated and cooled.

There is quite a generous flow of oil through these bearings, even at moderate speeds. Consequently, the gearbox is eminently suitable for service in remoter corners of the world, where operating conditions are severe or enormous distances have to be covered before even routine attention can be paid to the mechanism. Adequate provision is made for the box to breathe without admitting any foreign matter, a most important feature when operating in desert areas

Any commercial five- or six-speed gearbox is inevitably a complicated piece of machinery, and the design by Albion Motors Ltd, recently introduced on the Claymore and Nimbus chassis, is no exception to this rule. The accompanying illustration shows that this is a constant-mesh unit, with helical gears for all ratios except first and second, which have straight spur gears. Special care has been taken to ensure adequate lubrication of the mainshaft gears and of the dog clutches. Some of the oil thrown up by the layshaft gears is trapped and transferred to the hollow mainshaft, whence it is fed through radial holes to the plain bearings of the gears. Involuntary disengagement of the coupling sleeves is prevented by the use of grooved dogs.

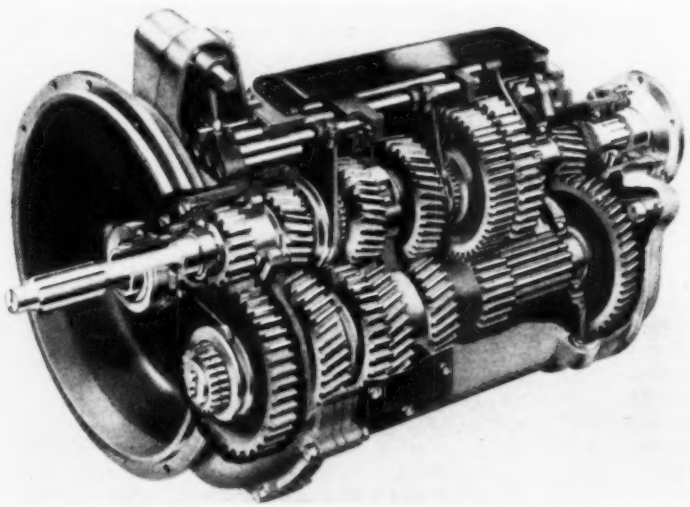
Albion Motors Ltd. and Scammell Lorries Ltd. both use the same design of transfer or relay gearbox on some of their chassis; this box was originated for the Albion Reiver model.



Front wheel drive is pneumatically engaged and is disengaged by spring pressure, a system that is now in vogue on a number of vehicles. Although this gearbox is not entirely new, it is yet another design in which hardened, ground and phosphate treated steel bushes—of En.36B steel—have replaced more usual bearing materials. In other respects, these two associated companies have concentrated on rationalizing their transmissions and reducing manufacturing costs, rather than indulging in speculative innovations.

The only new gearbox shown by A.E.C. is a small auxiliary unit on the new Regal Mark VI, and this provides a 1:1 straight-through drive for the fan, and a step-up ratio of 1·7:1 for the dynamo and water pump. Although the Regal Mark VI chassis is a mature design which can stand comparison with other similar chassis, it is difficult to give unqualified praise to the underfloor installation principle, because the essential auxiliaries have to be mounted remotely from the engine. This layout brings all the attendant problems of providing mechanical drives and, in some cases, remote control mechanisms.

A new five-speed gearbox has been provided by the British Motor Corporation Ltd, for its Austin and Morris 7 ton trucks. When the two-speed axle is fitted, this gearbox provides, in effect, two ranges of five



Above: David Brown six-speed gearbox, equipped for forward control, with top cover removed. All forward speeds are in constant mesh and are engaged by sliding dog clutches; reverse gear is of the crash engagement type

This Leyland gearbox is basically a five-speed unit, but is available with a built-in overdrive and a crawler gear, making a total of seven speeds; all the gears are in constant mesh

ratios rather than a series of ten rationally spaced ratios. This arrangement brings B.M.C. practice into line with that in America, where multi-ratio gearboxes appear to be favoured for long-distance hauls, and hydrokinetic torque converter systems where frequent stopping or short difficult journeys are to be undertaken.

The new gearbox is of exceptionally rugged construction and provides the following ratios: fifth, 1:1; fourth, 1·47:1; third, 2·39:1; second, 4·38:1; first, 7·58:1; reverse, 7·51:1. It is a constant-mesh unit with a simple spring-loaded baulking device to prevent the unintentional engagement of first or reverse. As is customary, two SAE Standard power take-off faces are provided for the fitting of drives to proprietary accessories.

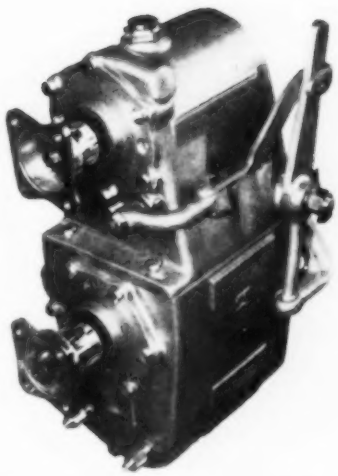
No new transmission has been introduced by Vauxhall Motors Ltd, but the adoption of a transmission handbrake on the Bedford 4 ton chassis has, in this respect, brought the company into line with the parent General Motors Corporation. The provision of a brake of this type focuses attention on other parallel developments: in France, for instance, retarders are compulsory on passenger carrying vehicles and the eddy-current type is widely employed; again, in the United States, the automatic transmissions produced by General Motors for their heavy vehicles incorporate a hydrokinetic retarder. It is therefore pertinent to speculate whether the introduction of a transmission brake foreshadows future progress in this field.

An interesting development by Leyland Motors Ltd., for their 1961 range of heavy-duty trucks, is the option of five, six or seven forward ratios. The basis of this scheme is a constant-mesh five-speed gearbox, to which an emergency low, or crawler, ratio or an overdrive, or both, can be added. First and second ratios in the basic gearbox have straight spur gears, while the other three have helical gears. When the crawler gear is required, the input is not taken through the normal internal pair of constant-mesh gears, but through a second pair, with straight teeth, housed at the front of the gearbox. The drive is transmitted from the layshaft to the third-motion shaft in the same way as when the five normal ratios are in use. For the overdrive, there is an additional pair of helical gears at the rear of the box. The ratios of the five-speed gearbox are: fifth, 1:1; fourth, 1·69:1; third, 2·755:1; second, 4·614:1; first, 7·243:1; reverse, 6·50:1. Crawler ratios of 9·31:1 forward and 8·36:1 in reverse are provided by the extra train, and the overdrive ratio is 0·766:1.

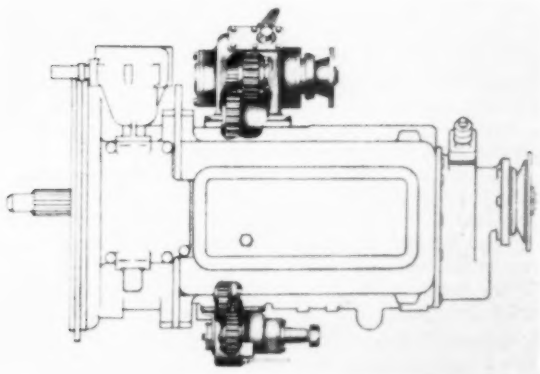
As would be expected, both the layshaft and the third-motion shaft have intermediate bearings. If the crawler train is fitted, the input gear is mounted on the primary shaft, and there is a ball bearing immediately ahead of it. The overdrive gears are overhung at the output end of the gearbox. Naturally, the selector mechanism of a multi-ratio gearbox of this type is most important and must be carefully designed and developed. The Leyland layout looks relatively simple: four selector shafts, disposed at the top of the box, have striker jaws at their front ends, and the striker lever is on a transverse shaft. This arrangement makes right-hand and left-hand control equally convenient.

Two SAE Standard power take-off positions are provided. From the near-side position, 20 b.h.p. can be transmitted, whereas full torque can be taken from that on the off side. In certain circumstances, these auxiliary drives can be engaged while the vehicle is moving.

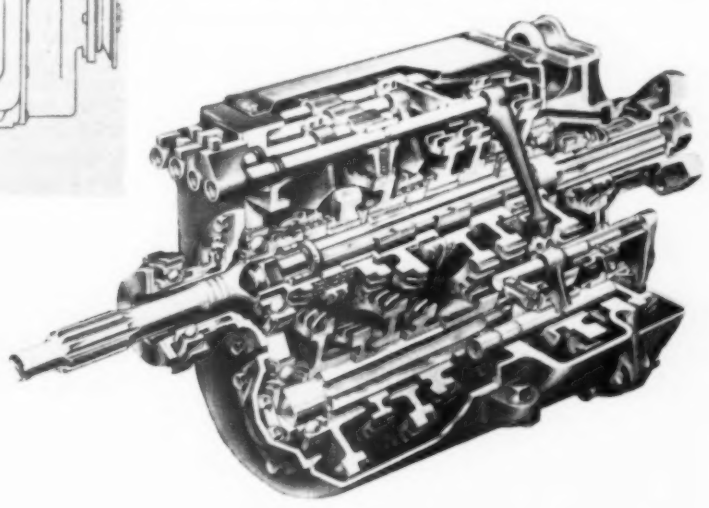
The Automobile Gear and Gearbox Divisions of David



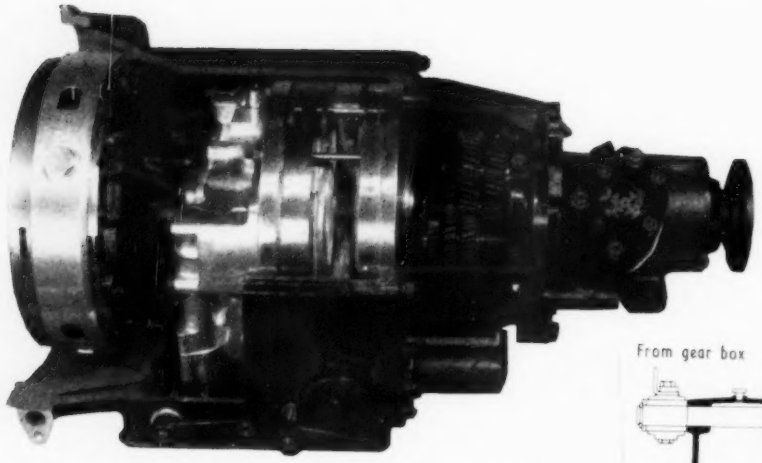
Martin Harper standard full torque power take-off. The maximum torque capacity is 240 lb-ft and a heavy duty model is available for torque outputs up to 550 lb-ft



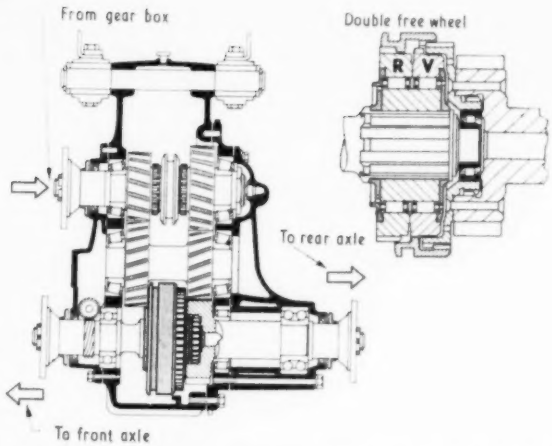
Above: There are two power take-offs, one on each side, on the Leyland gearbox that can be supplied with either five, six or seven forward speeds. That on the near side can transmit 20 b.h.p, while full torque can be taken from that on the off side



Right: This Albion five- or six-speed constant-mesh gearbox was originally designed for the Reiver chassis, but is also used on the Claymore and Nimbus range and on the Chieftain and Clydesdale models



Left: The Hobbs transmission unit, model number 1523, is now in production. Below: It is difficult to imagine a simpler device than this Daimler-Benz arrangement for providing automatic drive, to the front wheels of a four-wheel drive vehicle, whenever slip occurs at the rear wheels: it operates irrespective of whether forward or reverse gear is engaged at the time



Brown Industries Ltd. have developed the new Model 657 six-speed and reverse gearbox. This design follows established David Brown practice in having the housing split in a horizontal plane that passes through the axes of the shafts. All the forward gears have single-helical teeth; they are in constant mesh and engaged by sliding dog clutches having a spur tooth form. To be precise, there are two versions of this gearbox. In one, fifth gear is direct, and sixth is an overdrive ratio, while the other has a direct sixth gear. The ratios of these two variants are respectively as follows: sixth, 0·717:1 or 1:1; fifth, 1:1 or 1·592:1; fourth, 1·56:1 or 2·39:1; third, 2·45 or 3·73:1; second, 3·91:1 or 5·46:1; first, 6·61:1 or 9·23:1; reverse, 5·76:1 or 8·04:1. Both versions have been designed for a maximum engine torque of 480 lb-ft, and weigh about 535 lb complete with the clutch housing and forward control unit. As the ratios indicate, the Model 657 gearbox provides six rationally spaced gear ratios, rather than the alternative plan of two ranges, with which some overlapping of the ratios is difficult to avoid.

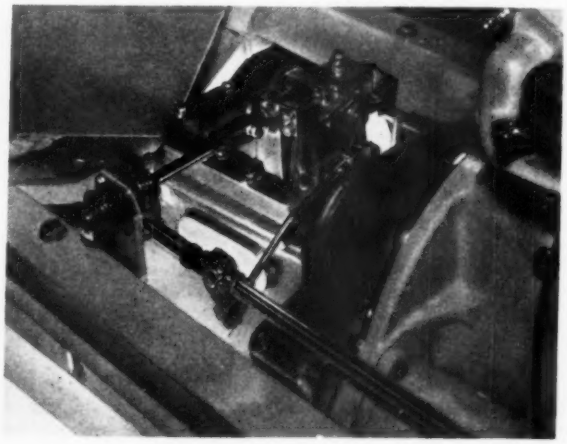
The gearbox is suitable for either unit or separate mounting, since the bell housing is a separate casting, and the forward control unit is suitable for either layout, besides being readily adaptable for right-hand or left-hand drive vehicles. Light alloy is used for the casings, a feature that necessitated the employment of steel liners to carry the bearings so that there is no likelihood of creeping of their outer races. Provision is normally made for two standard power take-offs and, in addition, a full-torque take-off can be mounted on top of the casing, if desired. Undoubtedly this is a well designed and well made gearbox, which will further enhance the prestige of this specialist transmission manufacturer.

In its specialization in transmission development, Zahnradfabrik Friedrichshafen AG, better known as ZF, is in many ways a similar organization to David Brown Industries Ltd. At Earls Court this year, there was a new ZF-Synchroma eight-speed gearbox known as the S8-45 unit. It was designed for input torques of 325 to 434 lb-ft, and weighs only 247 lb. There is nothing particularly unusual about the layout, but considerable attention has clearly been paid to detail design and development.

Not the least significant feature is that all forward ratios have the ZF baulk type synchronizing arrangement, which has proved itself to be one of the very best yet to be produced. In addition, a pneumatic servo attachment is available to reduce the manual effort of changing gear; it can be fitted whether direct or remote control is required. Versatility of application is assured by the suitability of the gearbox for unit or separate mounting. According to the customer's requirement, it can be installed so that the layshaft is below or beside the primary and third-motion shafts. At present, it appears that no provision has been made for a power take-off but this apparent omission could easily be remedied. Since it may be of interest to compare the ratios of the three versions offered, these are given in the accompanying table.

A most advanced all-wheel drive system is offered by Daimler-Benz AG on its type 322 and 337 trucks, which are 10·5 and 12 ton vehicles respectively. In this system, the drive to the front wheels cuts in whenever slip occurs at the rear wheels, irrespective of which forward or reverse gear may be engaged at the time. The driving characteristics of these trucks on slippery surfaces, such as snow and ice, have thereby been improved to a remarkable and praiseworthy degree.

A simple and efficient gear change mechanism is employed on the Standard Atlas van: selection is effected by rotation of the shaft, while the actual gear shift is made by fore-and-aft movement of the control



In general, the essentials of the system are two Borg-Warner sprag type clutches, one for each direction of rotation. These sprag clutches have been incorporated in the final drive of a two-speed constant-mesh transfer gearbox. Helical gears are used throughout this box and the dog clutch teeth are of the spur type to facilitate engagement of either of the two ratios. The two sprag clutches are mounted side by side on a common inner race, which is splined to the front wheel drive shaft of the gearbox. Two separate outer races are externally splined for connection, by a coupling sleeve, to the rear drive output shaft.

Although there is a neutral position indeed available, the coupling sleeve is intended in practice to have only two positions: one of these provides automatic front wheel drive when in forward gear, and the other provides it when in reverse. Should one of the rear wheels spin, the outer race tends to over-run, and thereby engages the appropriate sprags to drive the front wheels. It is difficult to imagine a simpler and more foolproof device to provide automatic drive to the front wheels in both directions of travel. Furthermore, the mechanical units necessary for the provision of this characteristic have already been well proved.

The association between Hobbs Transmission Ltd. and the B.S.A. group of companies was, of course, terminated earlier this year. It has since been replaced by an alliance between Hobbs Transmission and the Westinghouse Brake and Signal Co. Ltd, which is now producing the ingenious Hobbs Mecha-Matic transmission. The type 1523, fully automatic four-speed transmission, with manual over-ride, is being produced for Carl Borgward G.m.b.H, of Germany, and is eminently suitable for light commercial trucks and vans having engine torques in the range of 70 to 130 lb-ft. Other Hobbs transmissions, of a larger size, for a maximum torque of up to 1,100 lb-ft, are being prepared; indeed, a few five-speed fully automatic units are undergoing very strenuous tests in vehicles fitted with large engines of the V-eight type.

Table—GEAR RATIOS OF THE THREE ZF GEARBOXES

Ratio	*Maximum input torque, lb-ft*		
	325·5	376	434
Eighth	0·704:1	0·72:1	0·735:1
Seventh	1:1	1:1	1:1
Sixth	1·41:1	1·40:1	1·31:1
Fifth	2·01:1	1·936:1	1·78:1
Fourth	2·84:1	2·68:1	2·48:1
Third	4·03:1	3·77:1	3·38:1
Second	5·55:1	5·25:1	4·7:1
First	7·9:1	7·27:1	6·4:1
1st Reverse	6·42:1	5·94:1	5·24:1
2nd Reverse	4·54:1	4·29:1	3·84:1

Existing and well tried engine and transmission units are used to provide the power and transmission system for the Atlas Major 10/12 cwt van, which was shown for the first time by the Standard-Triumph Group. The gear-change mechanism is particularly neat. Its striker lever is on a transverse shaft, which protrudes from the gearbox cover, and a simple universal joint connects it to an extension shaft the outboard end of which is carried in a bearing mounted on the frame. This extension shaft is connected by a drop arm to the control rod.

Another small lever is welded to the control rod and linked to a lever that projects from the front of the gearbox cover. When the control rod is rotated, this small lever moves the striker lever within the gearbox in a transverse direction, thereby selecting a gear. The actual engagement is effected by longitudinal movement of the control rod. A conventional, hand lever gear-change control assembly is mounted conveniently at the forward driving position in the cab.

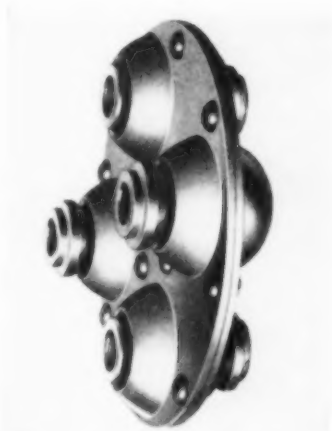
Propeller Shafts and Final-Drive Units

Developments in Respect of Flexible Couplings, Third Differential Locks and Limited-Slip Differentials; More Double-Reduction Axles

FOR a number of years, developments in the field of propeller shafts have been confined to detail modifications and improvements in manufacturing technique, although a very lively interest has been shown in constant-velocity and torsionally flexible joints. As is well known, Hardy Spicer Ltd. produces the majority of the propeller shafts for commercial vehicles as well as for private cars. This company's latest contribution to advanced design is its TR transmission coupling. In effect, this coupling is a flexible rubber joint and consists of two small steel cups; the inner one is attached to the end flange of a universal joint and the other to the companion flange of the gearbox or final-drive unit. A rubber ring is compressed, in sandwich fashion, between the two cups, and transmits the torque from one to the other. The rubber is therefore in pure shear.

Obviously, a flexible coupling of this nature can accommodate a limited amount of axial deflection. However, the main purpose of the arrangement is to minimize or, if possible, to eliminate those high-frequency vibrations that emanate from the engine and can cause objectionable drumming. In addition, this coupling provides a cushioning effect in the transmission, with beneficial effect upon the life of the universal joints and final-drive assembly. According to the experience so far gained, the TR coupling can be fitted at either end of the propeller shaft, but it has been found to be most effective when it is installed at the final-drive end.

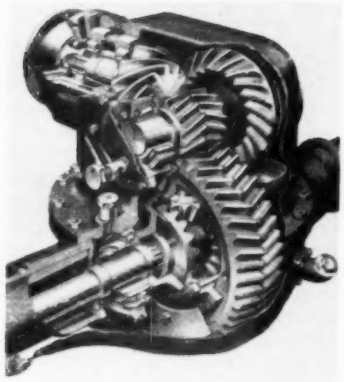
Metalastik Ltd. has long been producing a type of flexible coupling in which the drive is from two ball pins to two others by means of rubber bonded to the pins and compressed within a metal shroud, to which it is also bonded. The manufacturing technique employed for these couplings has



Metalastik universal coupling for propeller shafts and other applications. No lubrication is required, and the unit helps to reduce vibration and noise

undergone various modifications and, although the recent, riveted type was shown at Earls Court, it has already been superseded by another version. In this latest design, one pressing of the shroud is spun over the periphery of the other, thus forming a very clean looking component, which is less expensive and does not suffer from the other disadvantages associated with riveted units.

Various major manufacturers have made good progress with different types of constant-velocity joints, but none of them has yet secured a noteworthy lead in the commercial vehicle market. Numerically, the Birfield constant-velocity joint, formerly known as the Rzeppa joint, may possibly lead, since it is fitted to the new Austin 7 and Morris Mini-Van now that it has proved itself on the private cars from which these vans were evolved.



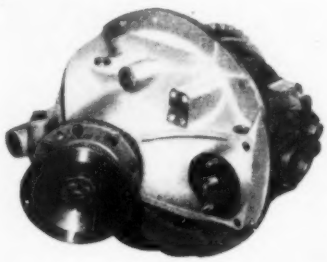
The eleven-tooth hypoid pinion of the Leyland double-reduction axle is of large diameter and its spiral angle is such that several teeth are in mesh simultaneously, so ensuring long life in service

Final drives

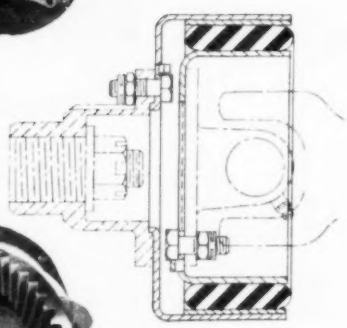
In the field of driving axles and final-drive units for heavy vehicles, Kirkstall Forge Engineering Ltd. is among the manufacturers occupying a leading position. Indeed this company has developed the final-drive units fitted to the heaviest road vehicles—of 120 tons gross train weight—built in this country. However, its extensive experience is not confined to the giants of the commercial vehicle world. An accompanying illustration shows a section through a final-drive assembly for a double rear-axle drive. The leading axle unit is equipped with a third differential, which can be locked by means of a very effective multi-disc, friction type device; this differential arrangement has now been developed to a very high degree of reliability. There is no doubt that a third differential is most desirable on a multi-axle drive system, but its benefits are nullified should one wheel spin. However, the differential lock can serve to maintain traction on the remaining wheels, thus preventing the development of a possibly dangerous situation.

There is, of course, the very good ZF limited-slip differential, which has been fitted for many years to certain road-going and racing cars, as well as to cross-country vehicles for civilian and military use. Its adoption in place of conventional differential units ensures the highest degree of traction under most trying conditions. The superiority of this particular design, however, is being challenged by a number of other devices for the same purpose.

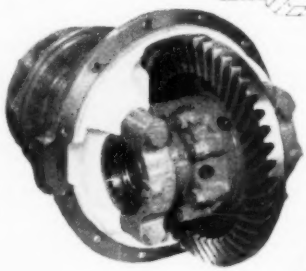
Surprisingly, all these devices originated in the U.S.A. One of them is the Thornton Powr-Lok limited-slip differential offered, for medium size commercial vehicles and for passenger cars, by Salisbury Transmissions Ltd. The demand for good traction in off the road conditions, or when the

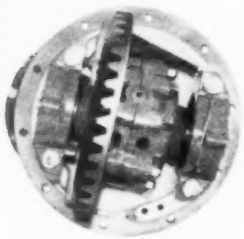


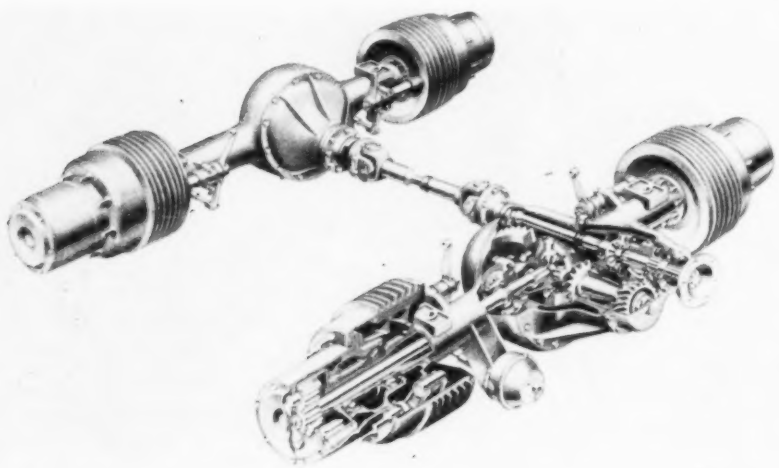
This driving head, with its 48 deg angled drive, was developed jointly by Leyland Motors Ltd. and Eaton Axles Ltd, for the Atlantean chassis



Simplicity is a noteworthy feature of the Laycock TR coupling shown on the right



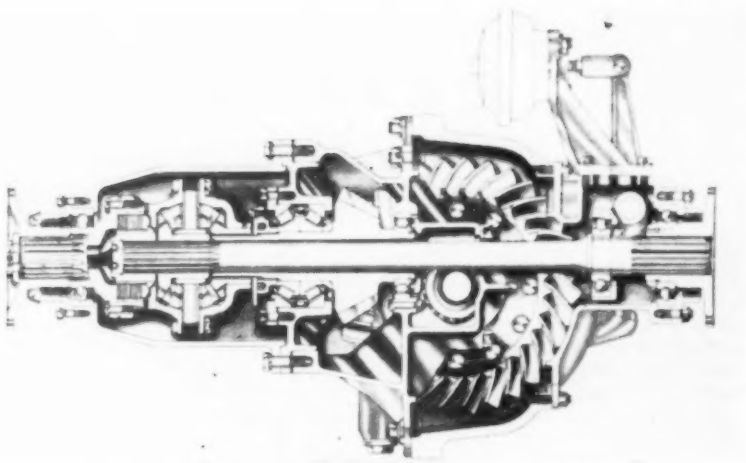




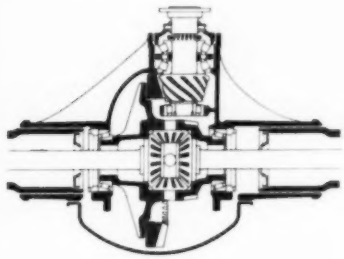
Above: E.N.V. two-speed axles: the upper view is of the 129 model and the lower one of the 130 unit. It is of interest that the input, which is eccentric to the bevel pinion, can be mounted in any position around its axis

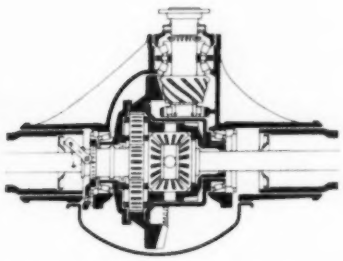
Left: The Leyland Power-Plus models have two hub-reduction rear axles, with spiral bevel drive and epicyclic gear trains in the hubs; the third differential can be locked by pneumatic means

The Kirkstall Forge Engineering Ltd. final-drive unit, with its third differential and multi-plate clutch type differential lock. This unit is for the 24 ton bogie and is designed for a gross weight of 60 tons



Below: Daimler-Benz AG have a double-reduction final-drive unit that can be accommodated in the same axle casing as the corresponding single-reduction gear





vehicle encounters ice, mud, oil or a loose surface, is met in this design by the introduction of additional friction within the differential unit. This is achieved by two small clutches, one at each side of the assembly. On the cross pins of the differential are machined V-section tongues, which register in corresponding grooves in the carrier: when a load is applied, the pins ride up the flanks of the grooves, thereby applying load to the clutches and so restricting the action of the differential.

The result of this arrangement is that, in normal driving and cornering conditions, the Powr-Lok unit functions in a similar manner to a conventional differential, but when one wheel begins to spin, considerably more torque is transferred to the driving wheel, until normal traction is restored to both driving wheels. Unfortunately, it is not possible to fit the Powr-Lok to differential assemblies that have not been designed to accommodate it. The E.N.V. Engineering Co. Ltd. is producing the new Trac-Aide controlled-slip differential, in which additional friction is used to arrest the spinning of a wheel in adverse conditions. Yet another type of frictional locking device for differentials is produced by Borg-Warner Ltd, of Letchworth.

To a considerable extent, current road conditions dictate trends of development in commercial vehicle design, and the Leyland-Eaton angle-drive rear axle perhaps exemplifies this fact. The arrangement has been developed as a result of collaboration between Leyland Motors Ltd. and Eaton Axles Ltd. It was originally evolved for the Leyland Atlantean coach but has been applied also to the B.P. Autotanker exhibited by Thompson Bros. (Bilston) Ltd. The assembly bears an interesting comparison with that fitted to the Daimler Fleetline, in which the angle-drive has been avoided.

Reference must be made to the new Leyland double-reduction axle, developed for heavy and ultra-heavy trucks. Hypoid bevel gears are used for the primary reduction. Since the reduction provided by these gears is very small, an exceptionally large and therefore robust driving pinion can be used. The secondary reduction is by double- helical gears to a bevel type differential. Perhaps the most meritorious features of this design are the compactness of the assembly and the positive lubrication system for all the bearings. A collector disc, bolted to one side of the large double-helical gear, feeds oil to a scoop and thence to one of the bearings carrying the combined double-helical pinion and hypoid wheel. Attached to the hypoid gear is a similar disc, which dips into an oil trough bolted to the inside of the differential housing, and lubricates the remaining bearings.

A neat solution to the problem of multi-wheel drives is shown in the accompanying illustration of one of the Leyland Power-Plus range of spiral bevel axles, which embody a hub reduction for each wheel. Daimler-Benz AG has designed a double-reduction final-drive unit that fits conveniently into the same axle casing as the corresponding single-reduction unit. Spiral bevel gears are used for both these units but the double-reduction version embodies an additional epicyclic reduction train. Locking of the sun gear to the annulus gear provides the direct drive by the spiral bevel gears only, whereas when the sun gear is locked to the axle casing, the second reduction is brought into effect.

The new Bedford two-speed axle is similar to the Daimler-Benz conception. It shows evidence of the careful blending of design and production requirements that has come to be expected of Vauxhall Motors Ltd. Vacuum actuation ensures quick and positive changes of ratio. As was mentioned in an earlier section, Dennis Bros. Ltd, for their latest design of van, have combined the final-drive and gearbox in one unit. The general layout is similar to that of other, lighter designs, except that pot type universal joints have been used at the inboards ends of the half-shafts. Various constant-velocity joints have been tried at the wheel ends of these shafts, but on the current production models, constant velocity is provided by the use of close-coupled, double Hookes joints.

REAR SUSPENSION

Increased Popularity of Non-Reactive Type Bogie Suspensions; Further Development of Air Suspension Components

DESIGNERS of commercial vehicles continue to adhere to well-established practice in respect of the rear suspension systems they employ; consequently, the majority of the models exhibited at Earls Court featured rigid live axles and semi-elliptic leaf springs, the latter performing the additional function of locating the axles. However, there are some interesting new developments and exceptions to the conventional approach.

Three of these exceptions to established practice are found among the newly exhibited vans: the Austin and Morris 5 cwt vehicles, the Renault Estafette and the Dennis Vendor, all three of which have front wheel drive and independent front suspension, also have independent rear suspension. On the B.M.C. products, the suspension is identical with that of the corresponding Austin and Morris cars, and consists of trailing arms, rubber cone type springs and telescopic dampers.

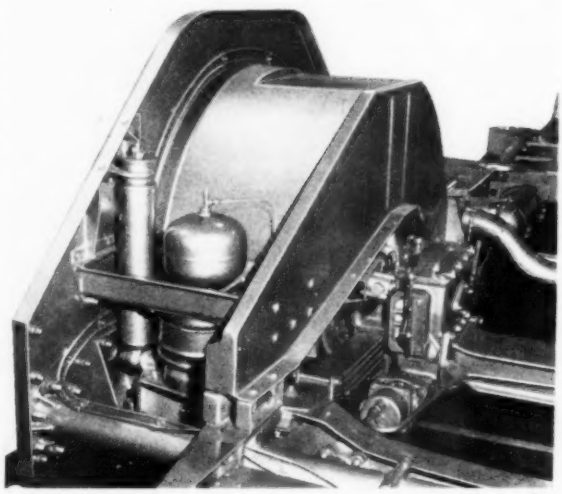
The rear wheels of the Renault Estafette are mounted on swing axles; coil springs form the suspension medium and are mounted coaxially with the telescopic dampers. As in the case of the front, the rear suspension of this vehicle is not carried directly on the body but is mounted on a cross member. This member is attached to the body by only four bolts and can therefore easily be removed for repairs or replacement. The independent rear suspension of the Dennis Vendor consists of trailing arms and truncated cone rubber springs, of Dennis design, which provide the desirable variable rate characteristics. Lever type hydraulic dampers are employed. The trailing arms are of Y shape, with widely spaced bearings; they pivot on a one-piece cross-shaft, and their bearings are Glacier bushes surrounded by rubber, to give a degree of resilience.

Most of the other light commercial vehicles retain the familiar Hotchkiss drive layout. Even the new 111 in wheelbase version of the Austin Gipsy 4 × 4 belongs to this majority, although on the standard 90 in wheelbase model, the original suspension, comprising trailing arms and Flexitor torsional rubber springs, is retained. On both models, incidentally, this last type of independent suspension is also employed, but in conjunction with an anti-roll bar passing through the hollow Flexitor units, for the front wheels. The decision to abandon the independent rear suspension on the long wheelbase model was influenced by the fact that a new suspension commensurate with the higher axle loading could be built more readily using standard conventional components than with new Flexitor springs. In addition, it was considered that the need for an independent rear suspension was not so pressing in a long wheelbase model, because a vehicle of this sort would be used less for the type of cross-country operation for which the original short wheelbase model was designed.

An interesting departure from normal practice in light and medium vehicle rear suspension is provided by the conversion of suspensions of two ambulance chassis to the Dunlop Pneuride air system. These two examples are the Appleyard Mark I FG Ambulance, based on the Morris FG chassis, and the Wadham LD Series III Ambulance, based on the Morris LD chassis. The conversions were carried out by the Dunlop Rubber Company Ltd. and the suspension fitted to both vehicles is of the flexible trailing link type. In this, the trailing links take the form of quarter-elliptic leaf springs and locate the axle longitudinally, while a panhard rod provides lateral location.

These trailing arms are extended to the rear of the axle a distance sufficient for the accommodation of the Dillow air springs, which are of the combined rolling-lobe and bellows type. Each leaf spring pivots on a bracket that takes the place of the normal front hanger bracket, and the whole suspension system has been developed with a view to replacing the standard rear springs with a minimum of modification to the existing frame members. The components are available in the form of a conversion kit, and a vehicle can be converted from conventional to air suspension at a relatively low cost.

Near-side rear suspension of the Dennis Loline Mark III bus chassis: the air spring can be seen adjacent to the telescopic damper; the leaf spring, the forward end of which is pivoted on the chassis frame, is used in conjunction with a panhard rod for location of the axle

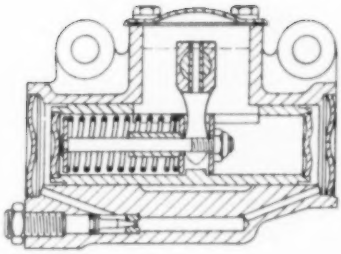


In this Dunlop suspension, the purpose of using flexible links is to increase its roll stiffness without recourse to an anti-roll bar or other device for restricting the roll. It will be appreciated that the flexibility of the link plays no part in the suspension unless there is a lateral transfer of load; by the simple expedient of using a flexible link having twice the periodicity of the semi-elliptic leaf spring that it replaces, the same roll stiffness is obtained. A further advantage of a link built from standard spring leaves is, of course, that it can be produced at a lower cost than could a fabricated component. Moreover, the use of a leaf spring for the link obviates the need for flexible mountings for the axle and therefore further reduces the cost.

The Dillow air spring, which was mentioned in the January issue of *Automobile Engineer*, is of a two-convolution bellows type, but the lower convolution is restrained by a

bell-mouthed skirt to form a rolling lobe on a piston. Such is the design of the skirt and piston that, for small deflections, the rolling lobe maintains a constant effective area, giving a low-rate spring. When the deflection is large, the bottom face of the lower convolution meets the upper face, and further deflection compresses the upper convolution axially, causing it to expand laterally. Since the effective area of the unit then rapidly increases, the spring rate also changes to a much higher value. The Dillow air spring thus provides what amounts to a two-stage characteristic, and over the most used part of the stroke it has a lower rate than the equivalent bellows unit. It is recommended for applications where frequencies of less than 90 cycles min are required without the incorporation of an extra volume tank, which is unnecessary unless an exceptionally low periodicity is required. The installed height of the Dillow component is, however, greater than that of the corresponding simple bellows type spring.

Another interesting feature of the Dunlop Pneuride suspension is the levelling valves which, during the course of development, have been simplified considerably and made more robust. A coil spring is now fitted between the lever and piston in the delay mechanism of the air valve; a delay of 8 to 12 seconds is stated to be the most suitable for commercial vehicles, since it is sufficient to make the levelling action inoperative under the influence of normal road irregularities. A noteworthy detail is the use of fluted nylon thrust pins in the air valve, the flutes acting as air passages. The body of the air valve also is a nylon moulding, which means that valve seats can be made integral with the body, and nylon is again employed for the injection moulded body of the air filter.



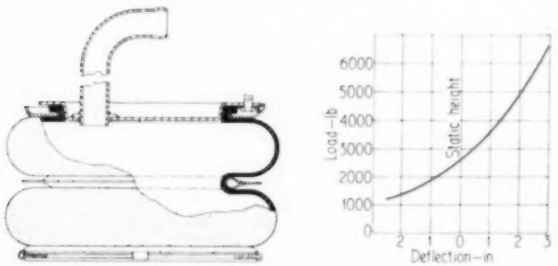
Longitudinal section through the delay mechanism of the Dunlop Pneuride automatic levelling valve

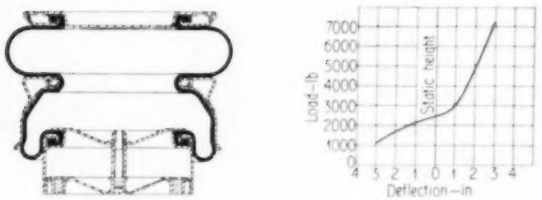
Improvements made to the latest Clayton Dewandre instantaneous action levelling valve have greatly increased the reliability of this unit. The lever-arm shaft now has generous bearing areas, and the operating spindle slides in a phosphor-bronze body. This body is screwed into the aluminium housing of the valve. The steel parts are chromium plated and the valve is completely sealed against the entry of dirt or water.

Other vehicles, exhibited at Earls Court, having air springs for their rear suspensions are the Dennis Loline Mark III and the Guy Wulfrunian, both double-deck buses. In the case of the Dennis Loline, the front suspension is conventional, in employing an I-section beam and semi-elliptic leaf springs, but at the rear the main function of the two leaf springs is to locate the axle, and virtually all the springing is pneumatic. These springs have four leaves and their forward ends are pivoted on the chassis frame. Their rear ends are bridged by an I-section beam, which is located transversely by a panhard rod. To provide adequate roll stiffness, the air springs are spaced well apart behind the wheels, near the ends of the beam just mentioned; they are of the single-convolution type with an extended air bag. Dennis Brothers Ltd. designed these springs, and the rubber units are produced by the Andre Rubber Company Ltd. Outboard of the two air springs are Armstrong telescopic dampers. In its essentials, this rear suspension is identical with that of the Bristol Lodekka chassis, described in the May 1959 issue of the *Automobile Engineer*. The Dennis Loline is, of course, based on the Bristol design.

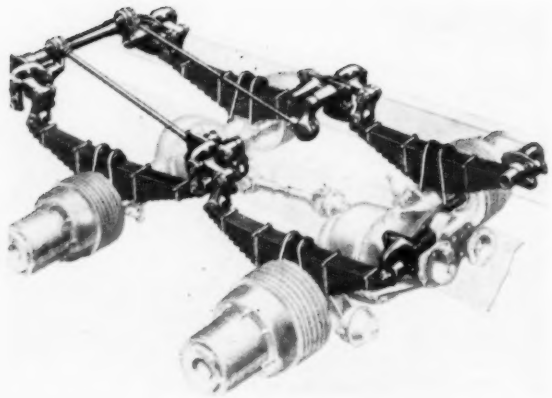
On the Guy Wulfrunian, the dropped-centre rear axle is located by a parallelogram linkage consisting of a trailing lower wishbone and two trailing upper links connected to the final-drive housings. At each side of the axle, and attached to it, there is a longitudinal beam on the ends of which are mounted the air springs. As in the case of this vehicle's front

Of the two Dunlop air springs illustrated below, the upper is of the bellows type, while the lower one is the latest Dillow unit. The load-deflection curve is shown to the right of each. An advantage of the Dillow spring is its low rate for small deflections from the normal





Dunlop Pneuride air suspension system with a Dillow spring; the leaf spring clamped to the axle and pivoted on the frame locates the axle and increases the roll stiffness



Leyland non-reactive suspension. Each axle is mounted on two semi-elliptic springs, with their front ends anchored to the frame and each rear end attached to one arm of a bell crank lever; the other arms of the pair of levers on each side of the chassis are interlinked

suspension, each of the four Firestone air springs is connected to an extra capacity tank. The rearmost spring units are particularly widely spaced but, in contrast to the arrangement on the Dennis Loline, the telescopic dampers are mounted well inboard.

Non-reactive suspensions

A feature of particular interest about the new twin-rear-axle heavy vehicle chassis exhibited by Leyland Motors Ltd. and its associated companies is the attention that has been given to improving the distribution of loading between the rear wheels. On these chassis, the rear suspension assemblies are so arranged as to balance the axle loads in both the presence and the absence of braking or driving torques. For instance, on the latest version of the eight-wheel Leyland Octopus, each of the two driving rear axles is mounted on two semi-elliptic leaf springs, which are anchored at their front ends to the chassis frame and attached at their rear ends to bell-crank rocking levers. The pair of rocking levers on each side are connected by a tension rod, so the rear ends of the two springs on each side of the chassis are linked and the forces on them are equalized at all times. Thus, the tendency for the second axle to lift when driving torque is applied is eliminated, with the result that traction is improved. Similarly, the tendency for the leading axle to lift during braking is also suppressed, so that full wheel adhesion is maintained.

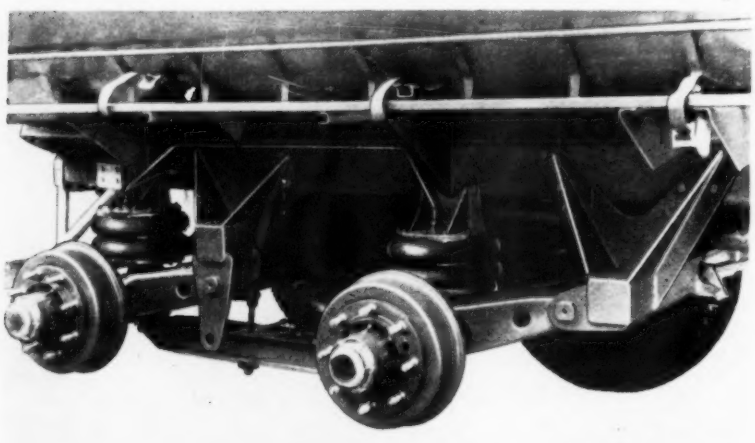
This type of non-reactive suspension is relatively light and is claimed to be particularly suitable for high-speed trunk road operation. Under other than highway conditions, when the axles might roll in opposite directions about longitudinal axis, the suspension is likely to be severely loaded. Consequently, should the vehicle be liable to regular operation on rougher terrain, the earlier type of trunnion mounted suspension, with a single inverted semi-elliptic spring on each side, is recommended. The earlier suspension has been improved by forming the ends of the main leaves into part-spherical pads instead of eyes, and using the springs to take only vertical and side forces. Torque reaction tubes stabilize the axles, and each trunnion bearing incorporates a rubber bush, which eliminates the need for lubrication.

A non-reactive bell-crank lever suspension, similar to that of the Leyland Octopus, was also shown on the Albion Reiver six-wheel chassis having twin driving rear axles. Another suspension of the non-reactive type is specified for the rear bogie of the Leyland Dromedary chassis, although the version exhibited on the B.P. Autotanker had two leaf springs for each axle, with a load-balancing rocking beam on each side, to connect the rear of the leading spring with the front end of the rear spring.

Two other examples of non-reactive suspension systems were exhibited by Scammell Lorries Ltd. They were on the 27 ft semi-trailer of the Handyman eight-wheel articulated outfit and on the 4,000 gal tank semi-trailer of the articulated ten-wheel Trunker. In the case of the Handyman semi-trailer, the four wheels that form the bogie are independently mounted, each being carried on a trailing arm and having its own stack of load-carrying rubber discs acting in compression. The trailing arms are pivoted on rubber trunnion bearings and allow each wheel to rise and fall in a vertical plane. Braking torque and side thrusts are taken by the arms, thus relieving the stacks of rubber discs of all duties other than carrying the load and controlling vertical movement.

At each side of the bogie there is an I-section balance beam, pivoted at its middle on the rearmost bogie cross member. By means of a short link, the beams are coupled at each end to the appropriate rubber stack, and so distribute the load evenly between the front and rear wheels. Also, they operate with the trailing arms to cancel out the internal reactive forces produced during braking. To obviate the need for lubrication, rubber trunnion bearings, as used for the trailing arms, are fitted to the pivots of the beams, and unlubricated fabric bearings are employed for the links and the top retaining discs of the rubber stacks.

The bogie suspension of the Trunker semi-trailer tanker is generally similar to that of the 27 ft semi-trailer, but it

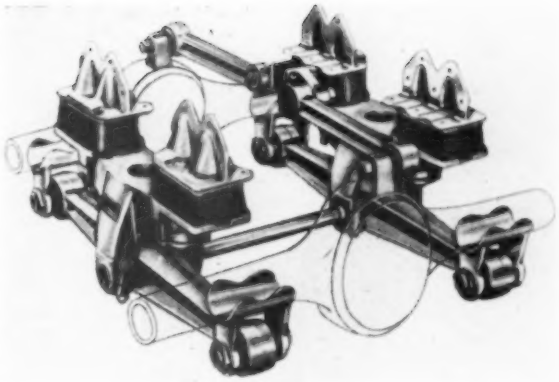


This Scammell non-reactive air suspension bogie has each wheel independently mounted on a trailing arm. There is a levelling valve on each side of the chassis and, since the effective base of the air springs is the wheel track, roll resistance is high

has air springing instead of rubber discs. As before, the four wheels of the bogie are independently mounted, each being carried on a trailing arm having its own 14 in diameter, two-convolution, Firestone air bellows. The trailing arms, which are pivoted on rubber trunnion bearings, react the braking torque and side thrusts, thus confining duties of the bellows to dealing with the vertical loading. Any tendency to roll is progressively resisted by the air springing which, with this design of bogie, acts at the full wheel track.

Air for the bellows is supplied from the brake air pressure reservoir on the semi-trailer. Braking efficiency is said to be unaffected by this arrangement, because a pressure regulating valve in the line prevents the suspension system from lowering the air pressure below 60 lb in^2. A levelling valve is employed at each side; the valves are of the delay type, to prevent the passage of air to or from the bellows during normal suspension movements. Incorporated in each air bellows is a rubber limit stop and, should one of the springs deflate, the vehicle is not immobilized, as it can travel for a short distance while riding on the limit stops.

Since the load is pneumatically balanced, there is no need for balancing beams between the leading and trailing axles, but there is a light fabricated beam at each side. Each of these beams serves a dual purpose: a connection between the middle of the beam and the levelling valve automatically corrects variations in frame height, and another rod, linking the beam to the frame, through a special rubber compression spring unit, acts as an additional anti-roll control. The rubber unit is in constant contact with its abutments, and gives progressive resistance to compression. All joints on the bogie have rubber bushes, so the only periodic lubrication required by the suspension is greasing of the hub bearings.



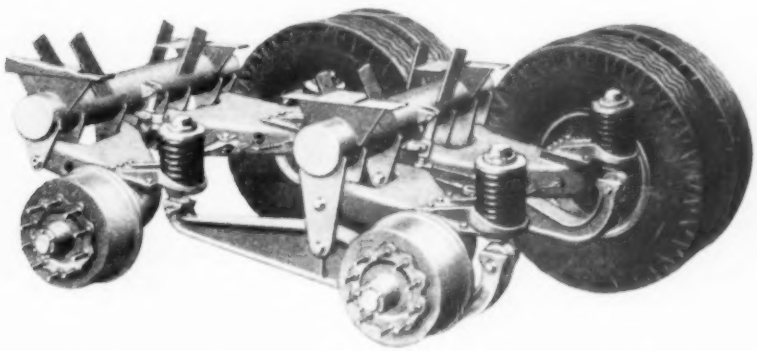
The Eaton-Hendrickson non-reactive suspension, as used with an Eaton 32M double-drive bogie on the A.E.C. Marshal. Of this whole assembly, the only imported components are the rubber cushions, which are designed to give a progressive but relatively stiff springing action

The suspension of the double-drive bogie of the Trunker tractor unit also is non-reactive. It is, however, of the Hendrickson type and incorporates an Eaton RS 320 rubber suspension unit. A similar suspension layout is used on the A.E.C. Marshal six-wheeler, which has an Eaton 32M double-drive bogie. Other vehicles with Eaton-Hendrickson bogie assemblies are the Eagle 3,250 gal tanker and the Hands QTLT trailer. It is of interest that the Hendrickson type of tandem suspension unit, which has already been made in quantity in the U.S.A, is now manufactured in this country —by Eaton Axles Ltd—the only imported component being the rubber load cushions.

In essence, this bogie assembly consists of two forged I-section rocking beams, one on each side, which carry the axles at their ends and which oscillate on trunnion brackets. Between these brackets and the chassis frame are deep, hollow, rubber pads, or load cushions, which are designed to give a progressive, if stiff, springing action. For a trailer installation, the deflection of the cushions between no load and full load is quoted as $\frac{7}{8}$ in. Location of the bogie assembly is effected by four vertical, rubber-bushed pins, each of which passes through one of the cushions, whereas torque reactions from the axles are absorbed by two rubber bushed radius rods. The pivots of the rocking beams are also rubber bushed, as are all the other oscillating bearings.

Trailer suspensions

Another new semi-trailer with rubber suspension is the So-Lo model exhibited by Charles Pitt (Barton Stacey) Ltd. This 6 ton low-loader has an independent trailing arm suspension system that makes the least practicable encroachment into the floor area. Each of the two stub axles is welded to the middle of a forged steel trailing arm, which pivots on a large phosphor-bronze bush carried on the frame, just ahead of the wheel. At the rear end of each trailing arm is a tongue that enters a vertical, tubular pillar mounted directly behind the wheel. Inside the pillar are two Aeon hollow rubber springs, one of which is mounted below the tongue and the other above it.



The layout of the Scammell non-reactive rubber suspension bogie, with its centrally pivoted balance beam on each side, can be seen clearly in this illustration. Each wheel is independently mounted on a trailing arm

The upper spring, which controls the bump movement, has three convolutions, and the lower or rebound spring has only two. To alter the suspension characteristics according to the load, the abutment of the upper spring may be moved, thereby varying the static compression of the springs. The rear ends of the trailing arms are guided by rubber mounted bobbins attached to them; these bobbins slide up and down on steel columns. Progressive action is a feature of the Aeon springs, and the suspension is said to have good anti-roll characteristics.

Rubber springing is used also on the dual-purpose Roadrailer, exhibited by the Pressed Steel Company Ltd. This vehicle can run on railway tracks as well as on roads,

where it takes the form of a semi-trailer. The Roadrailer has two pairs of wheels, one for road use, and the other for rail. On each side, a rail and a road wheel are disposed one at each end of a cast steel rocking lever arrangement, the road wheel being at the leading end. Each road-rail wheel assembly is sprung by a Dunlop Torsilastic rubber spring of about 10 in diameter. To change from road to rail wheels, or *vice versa*, both assemblies are partly rotated, about a suspension cross tube, by a ball screw actuator driven by a 6 h.p. Rotax air motor. During the changeover, both pairs of wheels are briefly in simultaneous contact with the ground.

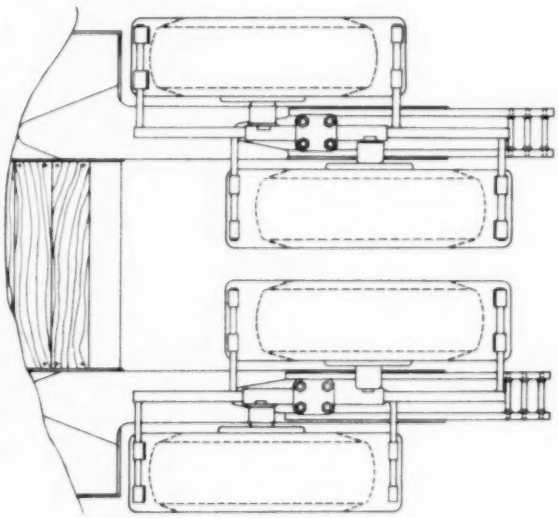
A different type of rubber suspension, suitable for commercial vehicles, was exhibited in model form by Metalastik Ltd. In principle this is similar to the previous Metalastik toggle link systems: the suspension assembly on each side of the chassis frame consists of two parallel control links of unequal length, a medial link equipped with large torsion bushes that provide the springing, and a vertical member connected to the three links and the axle. As the axle rises, the rubber bushes of the medial link are loaded in torsion and then also radially, giving the increase of rate with loading that is desirable for a good ride. This manufacturer also exhibited their new rubber auxiliary spring which has a progressive rate characteristic.

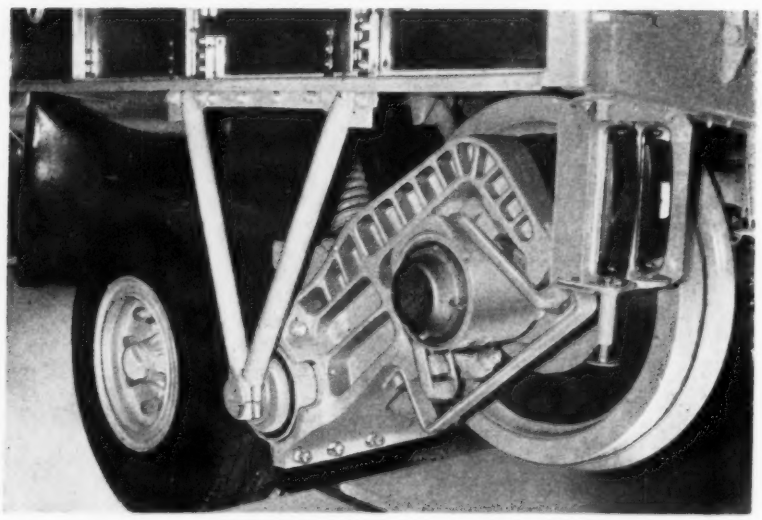
Although the use of air as the suspension medium is still confined to relatively few commercial vehicles, there is one type of vehicle in which it is rapidly becoming popular: this is the trailer, or more particularly, the semi-trailer. With these vehicles, air springing offers a good solution to the problems set by the relatively great differences between the laden and unladen weights which, with conventional springing generally result in unsatisfactory ride characteristics when the vehicle is running light. In contrast, air suspensions, because of their levelling valves, automatically adjust themselves to suit the load, and so ensure almost constant springing characteristics in all conditions.

It is therefore not surprising that, in addition to the Scammell Trunker already described, there are other new semi-trailers with air suspension. Cranes (Dereham) Ltd. exhibited a semi-trailer with two axles in line. Each axle has two trunnions, the housings for which are disposed one ahead of the axle and the other behind it. The trunnion pivots are carried in Ferobestos bushes mounted on a trailing radius beam. Since they have a common longitudinal axis, this mounting permits the normal transverse rocking motion of the axle. To minimize the horizontal displacement of the ground contact points during articulation, the axis is below that of the axle.

The radius beams are of fabricated construction and each is pivoted on a short shaft supported by brackets attached to the trailer frame; Ferobestos bushes are also used for the beam pivots. On the rear end of each beam, behind the axle, is mounted a two-convolution Firestone air bellows unit, the top of which is attached to a plate supported by a bracket on the frame. A height control valve is mounted adjacent to each air spring: it is bolted to the bracket just mentioned, and is connected to the beam by a link.

Another Cranes exhibit of interest was a 45 60 ton machinery trailer, which had the wheel axes of its oscillating axle bogie disposed in staggered formation. This arrangement is termed the Z-axle bogie and its purpose is, of course, to reduce the transverse line loading of the road. Each wheel runs on a stub axle; the two inboard stub axles trail 25 in behind the two outboard ones. Situated between each inboard and outboard wheel is a short beam, from which the stub axles project and which is mounted on a massive laminated spring. The arrangement permits lateral tilting of the spring in its gudgeons, on the well-known Crane principle, and a feature of this Z-axle is that is caters for





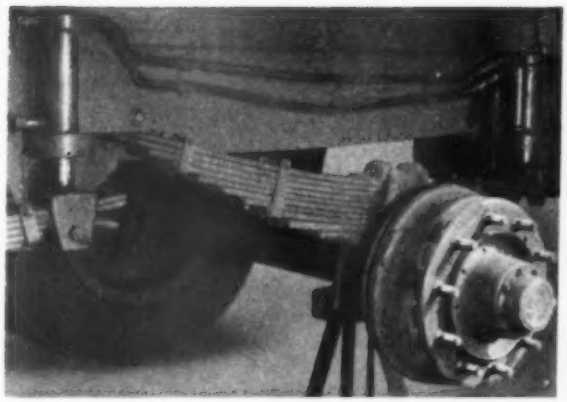
Above: Plan view of the Z-axle bogie arrangement of the Cranes 45/60 ton trailer. Each Z-axle is mounted on a heavy laminated spring, and articulation in both the longitudinal and lateral senses is catered for

Left: Road and rail wheel suspension assembly of the Roadrailer vehicle, built by the Pressed Steel Co. Ltd. The lowering and retraction of the wheels for road or rail use is effected by means of a screw actuator, which is driven by a Rotax 6 h.p. air motor

articulation of each beam in both the longitudinal and lateral sense When negotiating a hump in the road, or anywhere else, the leading wheel rises to accommodate itself to the road contour, and in so doing leans inwards at the top. When the rear wheel comes to the high spot it also tilts, but in the opposite direction.

A tandem bogie assembly with air springs was shown; it has been developed by Carrimore Six Wheelers Ltd. This assembly was designed for use with semi-trailers of 24 tons gross weight, and has a pressed steel sub-frame that carries the two axles. There are eight double-convolution bellows type air springs mounted in pairs, and the direct-acting levelling valves are actuated by a light transverse beam. The axles are located longitudinally by rubber-mounted parallel links, which are leading for the first axle and trailing for the second axle. These links also form brake torque reaction members. Two panhard rods provide transverse location, and the specification of the suspension includes four Woodhead-Monroe telescopic dampers.

For third axle conversions, a new form of suspension has been developed by the Primrose Third Axle Company Ltd. It has four identical leaf springs, two on each side, which are attached at their front ends to conventional hanger brackets. The rear ends of the springs have no eyes, however, but each abuts against the hemispherical end of a piston rod that is integral with a hydraulic piston. Special slipper brackets permit free longitudinal movement of the spring ends, while ensuring that they do not lose contact with the piston rods. Each hydraulic cylinder assembly is of the double-acting type, and the two cylinders on each side of the chassis frame are piped together. Because of this hydraulic interconnection, each piston reacts against the movement of its fellow, which clearly ensures that both axles of the bogie are always equally loaded. In other words, in contrast to the simple mechanical arrangement of four springs and balance beams, the Primrose system does not cause changes in the axle loading in response to braking torque reactions.



On the Primrose third axle conversion, the rear ends of the two springs on each side are supported by double-acting piston and cylinder assemblies, which are interconnected hydraulically to equalize the loading

Another new third axle conversion is that developed by the York Trailer Company Ltd, but this has leaf springs with a mechanical linkage. The third axle wheels are carried on independent trailing arms which are extended ahead of their pivots; their leading ends are supported by very long shackles connected to the rear of the springs carrying the other axle. The rear ends of the springs are freed, by removing the normal hanger brackets and shackles, and each interconnecting shackle bears on the main leaf, just ahead of the eye. It follows that the trailing arms, with their forward extensions, act as balance beams and cancel out brake torque reactions.

Front Suspension and Steering

Little Demand for Power-Assisted Steering on Vehicles of Medium Weight; Progress in Rubber and Air Springing Systems

FEW new developments are evident in steering systems. The demand for power assistance on vehicles of medium weight has declined and it is not offered as an option on the new TK series of Bedford trucks. A reduction of the front axle loading of the TK vehicles by comparison with that of their predecessors, as a result of the more rearward location of the engine mass, might be thought the main reason for this decision; but, in fact, the absence of any appreciable demand for power-assisted steering had caused the withdrawal of this option on Bedford trucks even before the introduction of the TK series.

On heavy vehicles, however, the use of power-assisted steering is increasing. Generally, the systems used are hydraulic, and on the new Leyland heavy goods chassis, which have this equipment as standard, hydraulic pumps, of course, are also standardized. The hydraulic booster operates on the drag link, except in the case of the Octopus, on which, since it has two steered front axles, the hydraulic jack actuates the relay drop arm between the two axles. In contrast to the general practice, the Leyland Dromedary chassis has Bendix-Westinghouse pneumatic assistance, again acting on the relay lever.

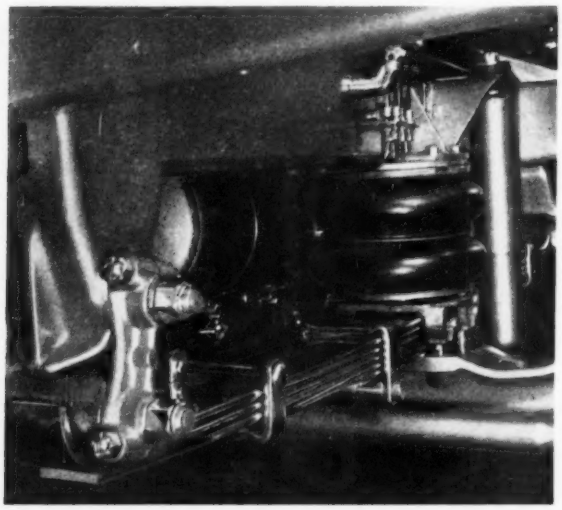
Two novel steering components deserve mention. One is the Marles high-flow valve intended to replace the normal type No. 3 valve for use with the company's type 661 steering gear. This valve has been designed to give satisfactory performance on very heavy or off-the-road vehicles, having hydraulic system flow rates of 18 gal min or more. Instead of providing a fixed ratio of manual to hydraulic effort it limits the manual effort to a predetermined low value. The other interesting new component is the Hoburn-Eaton roller type hydraulic pump, which is now produced in this country, under licence from the American Eaton Manufacturing Company, by the Hoburn-Eaton Manufacturing Company Ltd. In principle this is a vane type pump, but light, hollow rollers are employed instead of sliding vanes. The pump is capable of developing pressures of up to 1,200 lb in^2 and is manufactured in three sizes; the maximum flow rate is about 5 to 6 gal min.

So far as front suspension is concerned, the commercial vehicles exhibited at Earls Court this year demonstrated the continuing predominence of traditional suspension systems based on rigid axles and leaf springs. There is no lack of new developments in this field, and there are, in fact, several interesting departures from established practice. However, there is, as yet, no indication of any large scale move away from the conventional layouts.

This last comment does not apply, though, to light com-

mercial vehicles, in which independent front suspension is now almost universal. Although this fact is partly due to the higher standards of performance that are now expected of such vehicles, it is even more the result of further rationalization of car and van production. The four newcomers in the van field all have independent front suspenion, and in three of them, extensive use is made of car components. In fact, the B.M.C. 5 cwt model, produced in Austin and Morris versions, has an independent front suspension layout identical with that of the Austin Seven and Morris Mini-Minor cars. This system consists of double transverse links, with a radius rod, or drag link, connected to the lower one, and rubber springs and telescopic dampers.

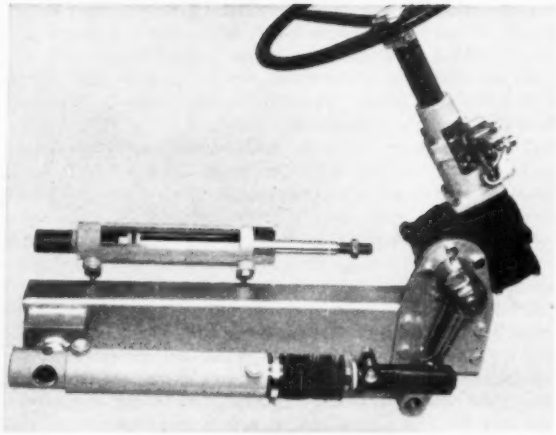
On the Austin and Morris 10/12 cwt vans, the front suspension is of the double wishbone and coil spring type; it is identical with that of the Austin A.55 and Morris Oxford saloons—even to the setting of the Armstrong IS 9/10 lever-type hydraulic dampers—except for the use of stiffer coil springs and a slightly different cross member. Similarly, the Commer 15 cwt van, described in the February 1960 issue of *Automobile Engineer*, has an independent suspension system similar to that of the Sunbeam Rapier and, consequently, of the other Rootes Group light cars. This van also features double wishbones and coil springs, and in this case, a $\frac{13}{16}$ in diameter anti-roll bar and Armstrong AT 10 telescopic type dampers are fitted. For obvious reasons, the Dennis Vendor 30 cwt van differs from the other newcomers in that car components are not used in its front



The Leyland Lion bus and coach chassis has an air and leaf spring suspension at the front. This system combines the advantages of pneumatic springing with the relative simplicity of axle location by means of leaf springs, but of course it is not without certain disadvantages too

suspension, which is completely new and features a transverse laminated leaf spring. This spring, which is mounted at the top of the assembly, forms the upper of the double transverse links, the lower of which are of the wishbone type. The spring has five leaves, and the suspension incorporates lever-type dampers.

Two other vans, which have been in production for some time on the Continent but which appear for the first time at Earls Court, are the Renault Estafette and the Mercedes-Benz L.319, 35 cwt van. The first has an independent front suspension of the double wishbone type with coil springs and coaxial telescopic dampers; the suspension assembly is mounted, with the engine, transmission and final drive, on



Marles number 4 type power-assisted steering gear, as fitted to the Scammell Super Constructor; an additional double-acting hydraulic cylinder, part sectioned, is mounted on the top of the display frame

a sub-frame attached by eight bolts to the body structure. On the Mercedes-Benz vehicle the system comprises a rigid, I-section beam axle and laminated semi-elliptic leaf springs, controlled by telescopic dampers. Again, however, the whole of the suspension together with the engine, transmission and steering, is mounted on a sub-frame which, in this instance, is bolted beneath the main chassis frame and insulated from it by four-layer rubber mountings.

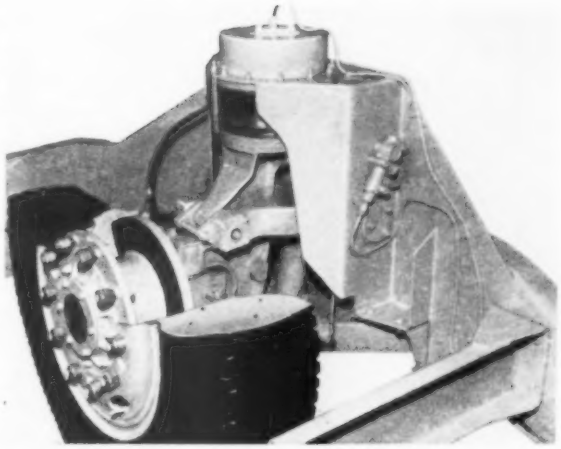
Possible improvements of the conventional suspension systems used on medium-weight chassis are well illustrated by the new Bedford TK series of trucks. The retention of a rigid beam axle and laminated leaf springs is justified on the grounds of low cost; to improve the ride, the suspension has been made softer by using longer, wider springs with fewer leaves. In consequence, the front suspension spring rate of the TK series is 40 to 45 per cent lower than that of the earlier Bedford trucks; the springs are now 58·5 in long and 3 in wide. In the case of the 3, 4 and 5 ton models there are six leaves, on the 7 ton model seven leaves and on the 7½ ton version eight leaves. Telescopic hydraulic dampers are used as before but, to cope with the more flexible springs, their diameter has been increased from 1 in to 1¾ in.

Another interesting feature of the Bedford TK series trucks is that 7.50-16 in tyres of radial steel cord construction, built by or under licence from the Michelin Tyre Co. Ltd, are now offered as the standard installation on the 5 ton model. On the 4 ton model, 7.00-16 in tyres of similar construction are optional in place of the standard 7.50-16 in, 10-ply textile cord tyres. Similarly, on the 6 ton chassis, 8.25-17 in radial cord tyres are offered as alternatives to 7.50-20 in textile tyres of 12-ply rating, giving the benefit of reduced loading height as well as the other inherent advantages of steel cord tyres. The reduced diameter is said to have no adverse effect on tyre life and, indeed, it is claimed that, in the case of the 16 in wheels, longer life has been recorded than with the larger diameter tyres. The wheels of the TK series trucks are of the square blank type and are of welded construction; this has reduced the unsprung weight, as compared with that of the earlier riveted type.

On heavy vehicles, front suspensions remain essentially unchanged, though there are three notable departures from conventional systems. These are the Leyland Lion coach and bus chassis, the Leyland Dromedary chassis of the B.P. Autotanker, built by Thompson Brothers (Bilston) Ltd, and also the Guy Wulfrunian bus chassis. The front axle of the Lion and the two steered front axles of the eight-wheel Dromedary are sprung by a combination of Dunlop

double-convolution air bellows and low-rate semi-elliptic leaf springs anchored and shackled in the normal way. This system combines the advantages of pneumatic springing with the relative simplicity of axle location by means of leaf springs, but also it retains the disadvantages of frequent attention and maintenance required by leaf springs. As fitted to the Lion, the Leyland air and leaf spring system includes two extra air reservoirs, which act as pneumatic buffers, and a variable-delay levelling valve that gives a constant frame height under all conditions of load. Also embodied are telescopic dampers, mounted slightly ahead of the air bellows. Springing of the rear axles of the Lion and Dromedary is effected by means of normal semi-elliptic leaf springs; and a conventional front suspension, as an alternative to the combination air and leaf springs, is offered on both chassis.

The chassis of the Guy Wulfrunian double-deck bus is a development of that of the Victory single-deck vehicle shown at the 1958 commercial vehicle exhibition. Like the latter, it has an independent front suspension, with unequal length wishbones and Firestone Airide rolling diaphragm type air springs mounted on top of the vertical links. The action of the spring units is controlled by telescopic dampers and the suspension geometry provides a total vertical wheel movement of 6 in, for a change of camber angle of only ¾ deg. By the use of rubber bearings and Glacier DU bushes, the need for front suspension lubrication has been eliminated on this highly sophisticated bus chassis, which has air springs at the rear as well as the front. The air suspension is controlled by an ingenious Guy system of linked valves, details of which unfortunately were not available for publication at the time when this report was prepared.



On the Guy Wulfrunian bus chassis, a double transverse wishbone type independent front suspension system is employed, and it operates in conjunction with Firestone air springs mounted above the vertical link

BRAKES

Further Improvements in Efficiency and Reliability; Disc Brakes Available on More Vehicles; Increasing Interest in Transmission Brakes; Better Equipment for Semi-Trailers

GREATER braking power than hitherto is now provided on many commercial vehicles, particularly those of the medium weight and heavier types. The reasons for this improvement are undoubtedly the higher speeds permissible on new motorways, and the recently raised speed limit on other roads, as well as the continuing general increase of road traffic. Moreover, it is evident from a study of the latest chassis and proprietary braking equipment that the importance of raising the standard of reliability in the interest of safety has been fully appreciated.

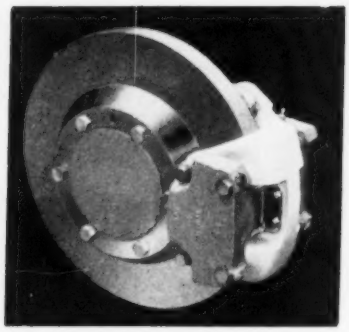
In many instances lining and swept areas have been increased, and there is wider adoption of independent operation of the front and rear brakes, or other means of ensuring that failure of one set does not affect the other. Similar precautions are taken regarding the brakes of tractor vehicles, the aim being at providing effective operation in the event of failure of the trailer brakes or breakaway of the trailer itself. Another significant development is the increase in the braking efficiency of semi-trailers, to eliminate jack-knifing.

Little further progress has been made with disc brakes, though the number of vehicles on which they are offered as optional equipment, mostly on the front wheels, has increased. The advantages these brakes offer for use on the single-tyred wheels of tandem-axle semi-trailers is also becoming more generally recognized. That disc brakes have not become more widely adopted is due to the recent improvements in drum brakes, which remain in almost universal use on the rear wheels of goods and passenger-carrying vehicles of all types. To some extent this fact may be attributed to the better performance and longer life afforded by the latest friction materials, of which the moulded variety has gained further favour. A promising development is the installation of power assistance for the hand brakes of vehicles carrying heavy loads. The servo equipment of this type still permits manual application of the brake should the source of power fail.

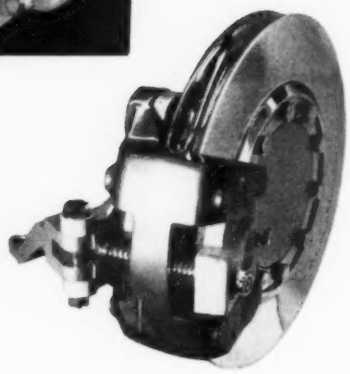
A feature of a number of the latest heavy vehicles is the optional or standard fitting of a transmission hand brake, mounted on the gearbox or rear axle, in place of the traditional drum application on the rear wheels; in several of the arrangements, the transmission brake has power assistance. Not only are such brakes very effective for emergency braking, but the elimination of the hand brake linkage from the rear wheels facilitates maintenance.

Exhaust braking does not appear to have made much headway in this country in spite of the practical and economic advantages it affords, but it is standard equipment on the two 13-ton Mercedes-Benz trucks that were exhibited. In an interesting alternative system seen at the exhibition, kinetic energy is converted into heat and dissipated through the cooling system. In view of the greater initial and installation costs of this system, it is doubtful whether it will prove a serious rival to more orthodox braking layouts in Great Britain.

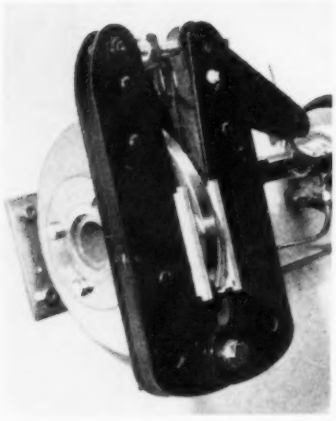
Separate disc and drum braking systems, for rail and road travel respectively, are installed on the new prototype Roadrailer semi-trailer exhibited by the Pressed Steel Co. Ltd. For rail operation, the two wheels on the rear axle of the bogie serve as brake discs and are gripped between segmental friction pads applied by Girling calipers; there is a separate diaphragm cylinder for each wheel. A step is machined on each pad to indicate when the wear is sufficient to warrant replacement. Three variations in the applied braking pressure are provided, to meet the requirements of different conditions of loading. When the vehicle is running empty, an 8 in



Ease of inspection and replacement of the friction pads is a noteworthy feature of the Dunlop disc brake for commercial and earth-moving type vehicles

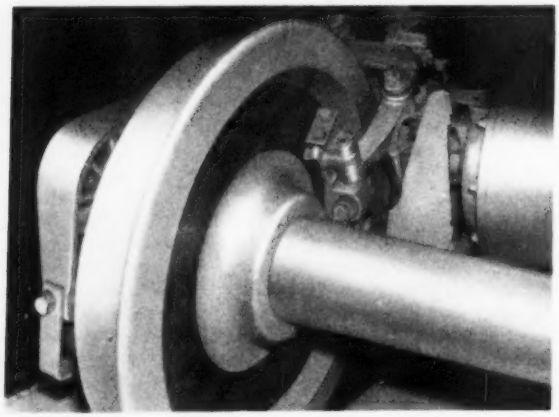


The robustly proportioned caliper of the Dunlop transmission disc brake for heavy commercial vehicles is similar in arrangement to that of the wheel disc brake made by the same manufacturer



In the new Lockheed, transmission type disc brake, the pressure plates to which the friction plates are bonded are located in slots in the pivoted levers and are easy to remove and to replace

The illustration below shows the arrangement of the vacuum cylinder and lever system for applying the Girling friction pads to both sides of the rail wheels on the Roadrailer; wear adjustment is automatic



diameter cylinder applies the brake on the right-hand wheel; in the half-laden condition, a 10 in cylinder operates the left-hand brake, and under full-load conditions both wheels are braked. To ensure against wheel locking, maximum retardation is limited to 0·08g.

The brakes are applied through a system of levers and linkages, which incorporates automatic adjusters. To give the appropriate braking for the load carried, a rotary valve is set, by means of a hand lever, to one of three positions, indicated by a dial on the side of the vehicle. On production vehicles, a weight indicator will show the correct setting of the lever. With the lever in a fourth position, the brakes are isolated, as is required when the vehicle is coupled to the rear end of a train and the axle load is insufficient for braking.

Included in the brake system is a direct-action valve, the purpose of which is to admit air rapidly to the actuating cylinders, thus eliminating delay in the application of the brakes. The incorporation of this valve is valuable when the vehicles are coupled in a long train, since it avoids the successive braking that would otherwise occur, with considerable delay in the case of those vehicles at the rear of the train. There is also a brake operated by a hand-wheel and screw, by means of which the vehicle can be held on a 1 in 37 gradient. This brake operates on only the right-hand wheel, but both wheels are retarded since they are mounted on a common axle.

The twin wheels used for road travel are equipped with Girling two-leading-shoe brakes, 5 in wide and operating in 12¼ in drums; Clayton Dewandre air cylinders are installed between the wheels. A compressor driven by the engine of the tractor vehicle charges a reservoir carried under the middle of the chassis frame. A relay valve is fitted in the pipeline between the reservoir and the brake cylinders to reduce the amount of air handled by the control valve of the servo.

No significant design changes have been made in the disc brakes offered by proprietary manufacturers for commercial vehicle use. A brake exhibited for the first time by the Dunlop Rubber Co. Ltd. is a more substantial version of the type already fitted to private cars and aircraft. It is also suitable for earth-moving vehicles, for which purpose it is fitted with sintered iron friction pads, which give longer service life than do asbestos-base pads under severe working conditions.

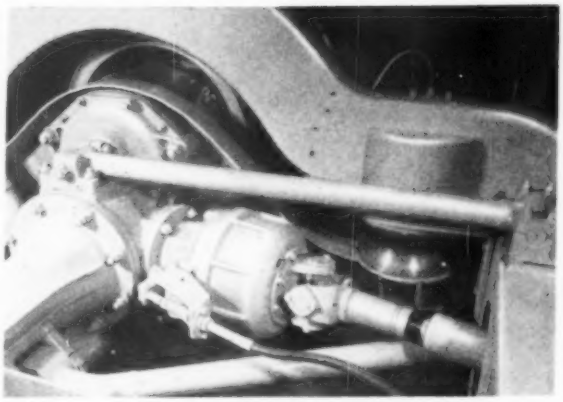
The caliper of the latest Dunlop transmission disc brake is generally similar to that of the wheel brake. On each side of the disc it carries a pressure plate; these plates pivot on vertical axes at their inboard ends, and the friction pads are bonded to them. The actuating lever is pivot mounted on the outboard end of one pressure plate and is connected to the other by a rod passing through a hole in the caliper casting. This rod is attached to the lever relatively near the fulcrum, and an adjusting nut is fitted on its end remote from the lever. Pad clearance is maintained by a pair of springs, one of which is carried on the rod between each plate and the side of the caliper.

E.R.F. is the first British manufacturer to offer disc brakes optionally on the front wheels of a production goods-carrying chassis; these brakes are of Girling manufacture. Two-leading-shoe drum brakes are the alternative equipment on the eight-wheel vehicle concerned. Both types of brake are applied by an air-hydraulic unit, whereas the rear wheel drum brakes are operated by air pressure diaphragms.

The latest Lockheed range of disc brakes for commercial vehicles includes single- and twin-cylinder types, available in a variety of bore sizes, for vehicles having gross weights up to 12 tons. Cast iron is employed for the caliper, which consists of a solid bridge, on one side of which is a cover secured by four bolts. The pressure plates, which carry bonded-on segmental pads, can easily be inserted or removed through a wide aperture. They are accurately located in the caliper and are retained by a single transverse rod that can be

Left: Segmental friction pads are used in the Girling single caliper disc brakes on the front wheels of the Guy Wulfrunian bus chassis

Right: The Girling drum type transmission brake on the rear axle of the Wulfrunian has two 4½ in wide leading shoes in a 9 in diameter drum



removed, without any difficulty, on withdrawing a split pin.

A Lockheed innovation is a transmission disc brake, also intended for vehicles of up to 12 tons gross weight. This brake is of the double pivoted lever type and can be mounted on the nose of the rear axle casing, on the rear of the gearbox or between the two assemblies. The two levers straddle the disc and are of fabricated, twin-plate construction. Their adjacent, inner edges are relieved to provide seatings for the pressure plates to which the friction pads are bonded. To ensure equal loading over the entire rubbing surface of both pads, the edges of the seatings are shaped so that they make line contact with the pressure plates. The plates are retained in position by tension springs anchored to the levers and are easily removed when replacement is necessary. The maximum torque that can be absorbed by the brake is about 25,000 lb-in.

This type of transmission brake is fitted to the 7½ ton vehicle in the new Bedford TK range. The other models in the range have drum transmission brakes, with which, it is stated, three emergency stops from maximum speed can be made without any noticeable fade occurring. On the forward-control 4 ton model and the 6 yd^3 tipper exhibited, the brake is applied by a pull-up hand lever which, located to the right of the driver's seat, does not obstruct entrance or exit. Owing to the absence of hand brake equipment on the rear wheels, it has been found possible to incorporate a new external type of brake shoe adjuster that can be operated with a spanner. The brake drums of all models in the new range are thicker than those of the previous equivalent vehicles by 60 per cent on the front wheels and 36 per cent at the rear.

Girling disc brakes are fitted to all wheels of the Guy Wulfrunian double-deck bus chassis. Those on the front wheels are of the manufacturer's standard single-caliper type. The discs on the rear wheels, each of which is braked by two calipers, are of Guy design and embody a special air-cooling feature. They are 1¼ in thick and are of sand cast Chromidium iron having good heat-conducting properties. The discs have deeply grooved outer edges and incorporate radial ventilation channels, which reduce the weight as well as induce a flow of cooling air across the hubs, through the discs and out between the twin wheels. A 9 in diameter × 4½ in wide two-leading-shoe drum transmission brake is mounted on the rear axle nose and is applied by cable and hand lever.

On the new B.M.C. 5 cwt van, the Lockheed hydraulic braking system includes a valve that limits the braking effort applied to the rear wheels when the pedal load exceeds 40 lb. This arrangement, which is also used on certain of the B.M.C. cars, is intended to prevent locking of those wheels when the vehicle is lightly loaded or is being driven over slippery surfaces. The braking effort is equally distributed between the front and rear wheels when the pedal load is below 40 lb.

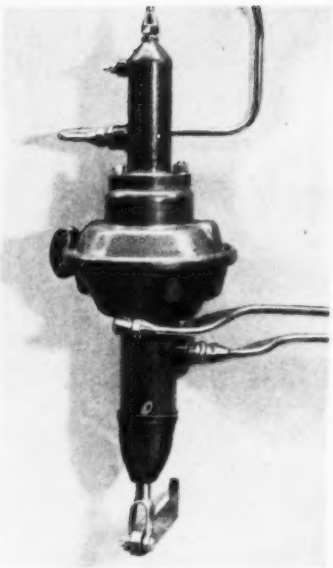
An unusual brake feature has been adopted on the Thornycroft 10 ton tipper, which has four driven wheels. To simplify control when the vehicle is operating under difficult conditions, the Bendix-Westinghouse air pressure brakes can be applied to all four wheels by a hand lever mounted on the steering column, as well as by the pedal. A new Westinghouse air operated concentric type diaphragm servo unit, for hydraulic brakes, dispenses with the lever mechanisms used in previous types, while maintaining the same advantages and powerful action. Output efficiency and sensitivity are said to be improved as a result of the elimination of friction and the consequent liability to wear. Any standard, hydraulic master cylinder can be fitted to the end flange of the unit.

The main features of the unit are a cylinder containing a piston, to which the pedal operated push rod is applied, and a diaphragm and push plate assembly. To the cylinder is connected the compressed air supply, and a control spring is fitted between the piston and the pressure side of the diaphragm assembly. To apply the brakes, the diaphragm, through the medium of another push rod, operates the piston of the master cylinder against the pressure of a return spring. Within the servo piston is a chamber containing a spring-loaded disc valve for the air inlet and exhaust; this valve has annular seatings. The exhaust seat is on the end of a passage, in the brake application push rod, that leads into the atmospheric pressure side of the diaphragm chamber.

Because of the resilience of the control spring, the initial pedal load applied to the servo piston is transmitted directly to the diaphragm and by this to the master cylinder piston. When resistance from the brakes reaches a certain value, any further applied effort tends to compress the control spring so that the servo piston moves towards the diaphragm, until the valve disc contacts the exhaust valve seating. Further movement of the piston relative to the diaphragm opens the inlet port, thereby admitting air from the valve chamber to the pressure side of the diaphragm, and applying further effort to the brake cylinders. Pressure continues to build up in the diaphragm chamber until it and the control spring pressure overcome the applied effort. The piston then moves away from the diaphragm until the valve disc comes on to the inlet seating, so cutting off any further supply of air.

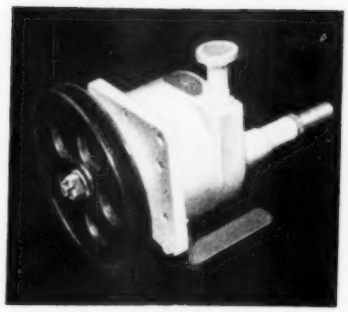
If additional effort is applied to the pedal, the piston again moves towards the diaphragm, and the pressure in the diaphragm chamber is increased until the balanced state is again obtained. When the pedal pressure is reduced, the piston moves away from the diaphragm, the disc moves off the exhaust valve seat, and air in the diaphragm pressure chamber escapes to atmosphere until the pedal effort is again balanced, whereupon the valve disc prevents further release of air. With complete release of the pedal all pressure escapes from the diaphragm chamber.

A new lightweight engine-driven air compressor is included in the latest Clayton Dewandre air servo system for hydrauli-

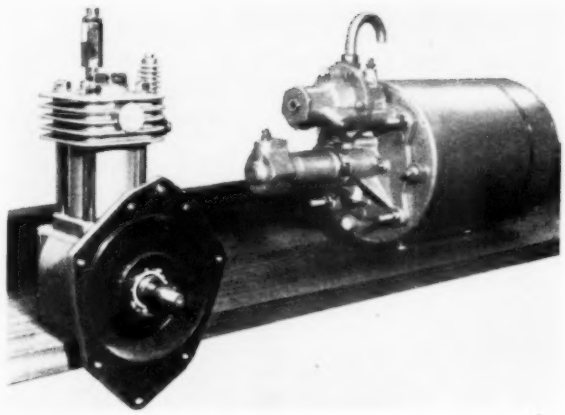


Left: Westinghouse air-operated, hydraulic brake, concentric servo and master cylinder, with a brake pedal rod connection at the bottom

Feeny and Johnson belt-driven exhauster for light, diesel powered vehicles; it incorporates a patented system of lubrication by wick



Right: Principal units of the latest Clayton Dewandre air servo system for hydraulically braked medium weight vehicles; the S.C.4 compressor is on the left



cally braked medium-weight vehicles. It is of the single-cylinder, air-cooled type and is known as S.C.4; its output capacity is 4 ft^3/min at 1,250 r.p.m. Lubrication is effected from the engine system: the oil is fed to a plain main bearing in one of the crankcase end covers and thence, through a drilling in the shaft, to the big end bearing. The small end bearing, cylinder wall and ball bearings carrying the other end of the crankshaft are splash-lubricated.

The inlet valve in the cylinder head is a circular disc, held on its seat by a light spring. Above it is a spring-loaded unloader valve controlled by a governor valve, the inlet of which is connected to the air reservoir. The delivery valve, also mounted in the head, is a square disc seated by a spring. When a pressure of 105 lb/in^2 is reached in the reservoir, it moves the spring-loaded ball of the governor valve from an upper to a lower seat. Air then passes through a drilling and depresses the unloader valve, opening the inlet valve so that no further air is compressed. When the pressure in the reservoir falls, the governor ball valve returns to its upper seating, thereby releasing air pressure in the unloader valve chamber to atmosphere, through a small hole in the side of the governor. Since the unloader valve then rises under spring action, the inlet valve functions normally again, and the compressor recharges the reservoir.

A safety valve is fitted to the cylinder head, above the delivery valve; it is one or other of two Bendix-Westinghouse types introduced to safeguard air pressure braking systems against the effects of excessive pressure. Each design incorporates a spring-loaded ball. In one layout, the valve stem and spring seat are integral, as also are the spring cage and valve body; in the other, however, these parts are separable. The spring loading can be varied by an adjusting screw.

The complete braking system, comprising the compressor and the latest Airpak servo unit, is designed as an alternative to the equivalent vacuum servo equipment, which consists of a Hydrovac unit and, if the vehicle is diesel engine driven, an exhauster. The power cylinder of the Airpak device is enclosed within the air reservoir. Its piston is mounted on a rod that actuates another piston, containing a ball check valve, in the hydraulic output cylinder. Control is effected by a hydraulic piston that actuates an assembly comprising a diaphragm, a two-stage air inlet valve and an atmospheric valve. One side of the control piston is in communication with atmosphere. There are only two external air pressure pipes. One is the main feed from the compressor to the reservoir, and the other connects the reservoir to the governor and unloader valve.

If the air pressure should fail, the check valve permits the fluid to pass straight through the output cylinder to the brakes, the system then functioning as a direct-operating one. When the servo is operating, normal pedal pressure opens only the first stage of the air inlet valve—the second stage comes into operation to provide rapid transfer of air to the power cylinder for full-pressure braking. Adequate feel of the brakes is provided by the transmission of reaction forces back to the pedal. There are three sizes of Airpak, to suit various weights of vehicle, and each is available with alternative sizes of hydraulic output cylinder.

The latest Dunlop hydraulic master cylinder for high- or low-pressure brake installations is of simplified design. Hydraulic fluid admitted through a pipe connection at the side first passes through drilled passages in a shallow flange at the inner end of the piston, and thence through more passages into the hollow end of the piston, which is exposed to the pressure side of the cylinder. Between the flange and synthetic rubber seal of the piston is a loose, gunmetal collar which moves away from the flange to permit entry of the fluid, but makes contact with the flange and so seals the holes as soon as there is a rise of pressure owing to the initial movement of the piston during brake application. A feature of the cylinder is that the seal is not deformed by passing over the pressure relief duct orifice, which is only exposed when back pressure is present in the system.

For small diesel-powered vehicles, Feeny and Johnson Ltd. have introduced a belt-driven exhauster of 4 ft^3/min displacement. It is normally supplied for clockwise rotation, though anti-clockwise units are available to order. Less than $\frac{1}{3}$ h.p. is absorbed in running the exhauster at 1,425 r.p.m. The unit is of the sliding-vane type and weighs about 11 lb without its pulley and silencer. A novel feature is a universal four-

way flange mounting, with two or more $\frac{3}{8}$ in bolts, for convenience of installation in any position. Lubrication is by wick feed: the oil is drawn in by the rotor, and sufficient is supplied to all working parts without risk of flooding.

The new Clayton Dewandre A350 rotary, sliding-vane exhauster is also intended for vacuum-operated braking systems. It is of the engine-driven type, has a normal operating speed of 2,500 r.p.m. and weighs about 12 lb. The body and end covers are of cast iron, and house an eccentrically mounted aluminium rotor cast on to a steel shaft, which runs in two sintered bronze plain bearings or in one of these, in the rear end cover, and in a roller bearing in the drive end cover. In the rotor are four equally spaced radial slots that accommodate fibre blades. Lubrication is by engine pressure feed, and seals prevent oil leakage and the ingress of air and dirt.

For tractor vehicles equipped for towing trailers and having two-pipeline air pressure braking systems, the Clayton Dewandre tractor protection valve, introduced at the last Commercial Vehicle Show, is now in production. It ensures that sufficient pressure is retained in the tractor reservoir for brake application should the trailer break away or the pipeline couplings become disconnected. The unit is mounted at the rear of the tractor and connected by pipe to the reservoir and brake valve and, through two shut-off cocks and hose couplings, to the trailer service and emergency lines. These two lines are connected to a relay emergency valve on the trailer, and this valve is also coupled to the trailer brake reservoir and brake cylinders.

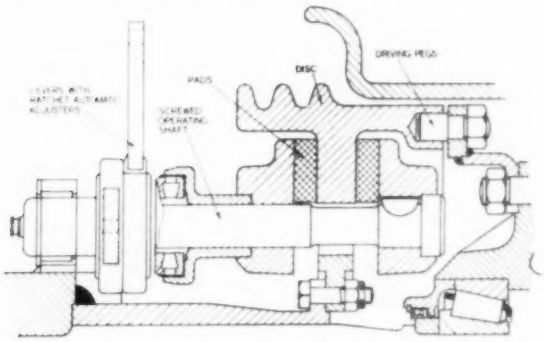
The valve assembly consists of two valves, mounted side by side in the body and connected by a drilled hole. One of these valves is a diverter, controlling the emergency line, and the other is for the service line. Each is of the conical, rubber faced type and is lifted by an air bellows against a spring normally set to 65 lb/in^2 preload. One type of valve fitted has adjustable setting screws, and another is adjusted by shims under the cap nuts. Air from the tractor reservoir flows past the diverter valve stem, through a drilled passage into the cavity containing the diverter valve bellows, thence through another passage to the base of the service valve and the inside of its bellows. Normally, the springs hold both valves on their seats, stopping the flow of air. One side of each bellows is vented to atmosphere.

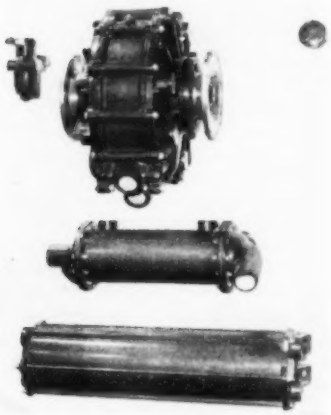
When air pressure from the tractor reservoir, acting on the bellows, oversomes the thrust exerted by the valve springs, the two valves are lifted off their seats. Air then charges the trailer system, and the tractor-trailer service line is open for trailer brake operation when the tractor brakes are applied. In the event of a trailer breakaway or coupling disconnection, air escapes until the trailer reservoir pressure falls to more than 10 to 20 lb/in^2 below the valve spring setting. The springs then close the valves so that the emergency and service lines are sealed, while sufficient air pressure is retained in the tractor reservoir for brake operation. To restore normal operating conditions, it is necessary for the trailer to be reconnected or, if the tractor is to be driven on its own, for the shut-off cocks to be closed.

Ample provision for safety is made in the new Lockheed divided line braking system. Not only is there complete separation of the front and rear braking circuits, but an electrical fluid level indicator, incorporated in the hydraulic supply tank, gives either an audible or a visual warning, or both, to the driver when the fluid reaches a dangerously low level. This level can also be seen, because the tank is of translucent plastics material, which withstands relatively high temperatures and can therefore be situated in the engine compartment. There are two separate master cylinders, contained in one body, with separate feed lines from two small supply compartments in the single reservoir; consequently, in the unlikely event of a fracture of one pipeline, the braking of only one axle is affected, and this is indicated by the warning device.

The air-hydraulic servo unit fitted to this system consists of two completely independent portions fed through twin lines from a common air supply. A compressor of dual type could be used for this system. The input ends of the hydraulic slave cylinders in the unit are connected to the separate master cylinders, and their output ends to the brake cylinders of the front and rear axles respectively. An integral air reservoir is embodied, in which compressed air is retained by a non-return valve should the supply fail, brake application by the pedal being unaffected until the pressure becomes too low. If required, vacuum instead of air assistance can be provided, by the use of a Lockheed dual Hydrovac in place of the air servo.

A new series of Lockheed Airpak units has been introduced for vehicles with air pressure braking. These units have

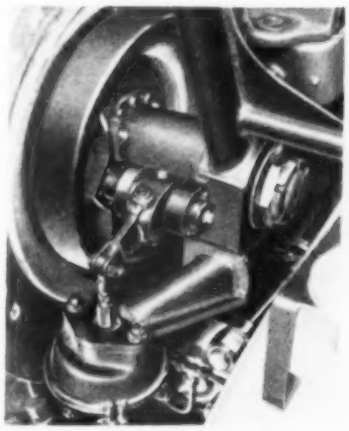


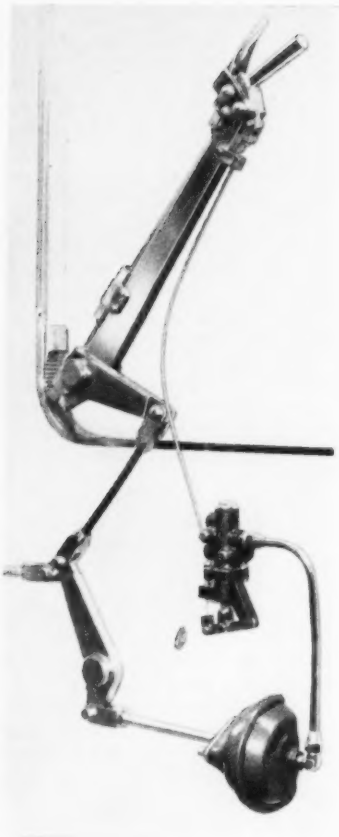


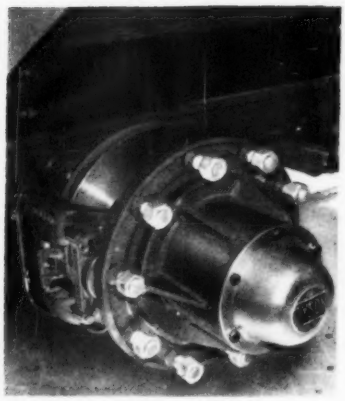
Above: Section through the disc brake for the Cranes 45/60 ton trailer, showing the large diameter, peripherally flanged annular disc

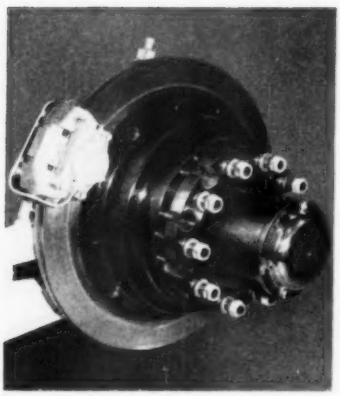
Principal components of the Thompson retarder: the rotor-stator unit, for installation in the propeller shaft drive, is visible at the top of this illustration

Mechanism for applying the disc brakes on the four wheels of the Z-axle of the Cranes 45/60 ton trailer The air diaphragm cylinder is at the bottom









Above, right: On the Mickleover 24 ton milk tanker, the Dunlop discs are in the form of 24 in diameter rings secured to the brake drums previously used

Centre: Dunlop single caliper air-hydraulic disc brake on the Dyson Aerovan tandem axle semi-trailer unit

Left: Display of the Westinghouse air pressure assisted hand-brake, as fitted to the Thornycroft Antar

output characteristics comparable with those of the established Lockheed Hydrovac range; they are suitable for vehicles having a gross weight of up to 24 tons. Though the piston of the Airpak power cylinder is, of course, operated by air pressure instead of vacuum, the new unit is of generally similar design to the Hydrovac. It has an integral reservoir of sufficient capacity for emergency conditions, eliminating the need for a separate container, and has been designed to accommodate an integral unloader valve; alternatively, a direct pipe connection to this component can be provided.

The Thompson retarder has been introduced by Automotive Products Co. Ltd. to relieve the normal braking system in decelerating a vehicle and controlling its speed down long gradients. It converts the energy into heat, most of which is dissipated through the vehicle's cooling system, the remainder being radiated from the retarder's finned outer surface. The Thompson unit operates on the fluid coupling principle and has no frictional surfaces to wear or require adjustment.

A petroleum-base hydraulic fluid forms the energy converting medium of the device, which can safely be applied at any speed and, within the heat-dissipating limits of the cooling system, for any length of time. The main components are a rotor-stator unit, designed for insertion in the propeller shaft drive, a heat exchanger, a reservoir, hose connections and a driver's control. The rotor, which has a toroidal cross section and radial guide vanes, rapidly accelerates the fluid, at the same time redirecting it along a toroidal path. When the fluid leaves the periphery of the rotor, it is at its maximum velocity, and is then directed into the stator. The stator has the same cross section as the rotor but, being stationary, retards the fluid, though its redirection along a toroidal path is maintained. This retardation continues until the fluid re-enters the eye of the rotor, to be accelerated again. Energy is, of course, taken continuously from the propeller shaft in accelerating the fluid, and is converted into heat during the subsequent deceleration.

On its transfer from the rotor to the stator, some of the fluid is diverted by the self-pumping action into a tangential passage, whence it flows through a flexible hose to the heat exchanger, which transfers the absorbed heat to the cooling system. The cooled fluid is then returned to the retarder through another hose, and directed into the eye of the rotor. It is, therefore, apparent that the retarding action is a continuous, self-sustaining cycle.

A reservoir, or loading cylinder as it is called, stores the fluid until retardation is required. The driver then actuates the control valve, which causes compressed air to force fluid from the cylinder into the retarder circuit. The pumping pressure and amount of energy absorbed are determined by the rotor speed and the amount of fluid in the retarder. By varying the valve setting, and hence the air pressure, an appropriate distribution of the fluid between the loading cylinder and the retarding system is obtained. If the retarder tends to absorb more power than the valve setting permits, the pumping pressure exceeds the air pressure, and fluid is forced into the loading cylinder until a balance is reached. Thus, the driver can vary the retardation from zero to the maximum for any particular vehicle speed; the capacity of the installation is governed by the maximum air pressure permissible in the system. When the retarder is brought into use, the air initially entrapped in the closed circuit is compressed by the pressure applied to the incoming fluid; relaxation of that pressure, by the returning of the control valve to its neutral position, causes this air to expand again, so that the fluid is transferred back to the cylinder.

Departures from previous disc brake practice have been made by two semi-trailer manufacturers. One of these manufacturers, Cranes (Dereham) Ltd, has evolved an interesting experimental layout for the Z-axle four-wheel rear bogie of a 45 to 60 ton machinery trailer built for Pickfords. The problem of providing the necessary high friction pad pressure is solved by mechanical application with assistance from an air pressure diaphragm unit. Discs of unconventional design are employed: each comprises a deep rib, 1¼ in thick, cast within a wide steel drum of 18 in diameter; the rib is situated mid-way between the ends of the drum. Four moulded segmental pads, ¾ in thick, are bonded and riveted to a clamping shoe on each side of the rib, the contact area of the pads being nearly half that of the disc. The inboard clamping shoe is keyed to the flanged end of the operating shaft, which passes through the outboard shoe and then through a short sleeve, at the end of which is a taper roller thrust bearing assembly.

A four-start Acme screw thread machined on the shaft, near its outboard end, engages in a nut actuated by a lever. The lever is linked to a Westinghous operating diaphragm and fitted with a ratchet and pawl automatic adjuster. When the lever is moved, the operating shaft is pulled outwards and the sleeve thrust inwards by the nut, so that the shoe pads grip the disc with an equal pressure on each side. The only connection between the wheel hub and the drum are twelve driving dowels, which are mounted in the hub and register in holes in the periphery of the drum. As a result, little of the generated heat is transferred to the hub, most being absorbed into and dissipated by the considerable mass of metal of the drum; the screw and nut, too, are well away from the disc.

A noteworthy feature of the one hundred and fifty 24 ton articulated milk tankers supplied by Mickleover Transport Ltd. to United Dairies is that each has been equipped with disc brakes by adapting the existing four trailing wheel hubs and discarding the drum brake equipment. This work was carried out in collaboration with Scammell Lorries Ltd. and the Dunlop Rubber Co. Ltd. The discs are 28 in diameter and 1½ in thick; they are bolted to the hubs, and are well clear of the wheels in order to provide adequate air cooling. The brakes are hydraulically applied by Dunlop equipment, and are said to have given more efficient service than the drum brakes previously fitted.

Another semi-trailer equipped with disc brakes is the new Dyson Aerovan. Again, Dunlop equipment is used: it is applied to both of the tandem axles, which have air suspension. Each disc has two Dunlop calipers, and its mounting on the hub holds it well clear of the wheel. The brakes are applied by air-hydraulic equipment. In addition, the brakes on the leading axle embody Dunlop mechanical calipers, actuated by cable from the hand lever.

It is claimed that hopping of the leading axle during braking is effectively prevented on the new Tasker twin-axle 16 ton semi-trailer. This axle carries a load of about 9 tons and is fitted with twin-tyred wheels and Girling 15½ in diameter × 6 in wide two-leading-shoe brakes. Since the trailing axle carries only 5 tons, it is of lighter construction, and has single wheels fitted with 15½ in × 3½ in brakes. Application of the brakes is effected by diaphragm type cylinders mounted in the middle of the axles.

The two rear springs on each side are articulated by a balance beam having arms of unequal length; the rear end of the heavier, leading, spring is shackled to the shorter arm of the beam. Owing to its lighter loading, the trailing axle is efficiently braked with considerably less applied braking effort than is required for the leading axle, with a consequent reduction in the force tending to lift the leading axle during braking. The force is, in fact, approximately halved by this arrangement. In addition, the oscillations that tend to create axle hop are obviated by twin-piston hydraulic dampers, mounted one on each side of the chassis frame and acting on the longer arms of the beams. The combined effects of these features ensure smooth, uniform braking, and radius rods are unnecessary.

Air assistance of the hand brake is becoming increasingly favoured, and is now available on certain Guy and Leyland models as well as being fitted as standard to the Thornycroft Antar Mark III. The Westinghouse equipment of this type, which is employed on the last-named vehicle, includes a control valve and a diaphragm cylinder. A short, flexible steel cable connects the drop arm of the hand lever to a bell-crank lever, one arm of which is coupled to the push rod of the diaphragm cylinder and the other to the brake tie rod. Cable operation is provided for the valve, which controls the air supply to the cylinder. The cable is attached to a pivoted lever, on the hand brake control, which the driver actuates to disengage the ratchet pawl when applying the brake. Movement of the brake lever thus causes air to be supplied to the cylinder, to assist the manual effort.

Once the brake is fully applied, air is released from the cylinder but the brake is held on by the ratchet mechanism. When the driver grips the hand lever to release the brake, air pressure is again supplied to the cylinder to relieve the load on the ratchet, but is cut off when the hand lever is returned to its off position. The flexible connection between the hand lever drop arm and the bell-crank lever permits the pawl to be disengaged while a braking force is being applied.

In an alternative arrangement, as installed on the Leyland Octopus eight-wheeler, a diaphragm cylinder is not used; instead, a pull type brake valve is incorporated in the tie rod system from the hand lever. This valve is operated when the hand brake is applied and supplies compressed air from the reservoir to the brake cylinders. Since it is of the progressive type, the degree of air assistance is proportional to the movement of the hand lever. Manual application is unaffected by failure of the air supply or by fracture of one of the pipelines.

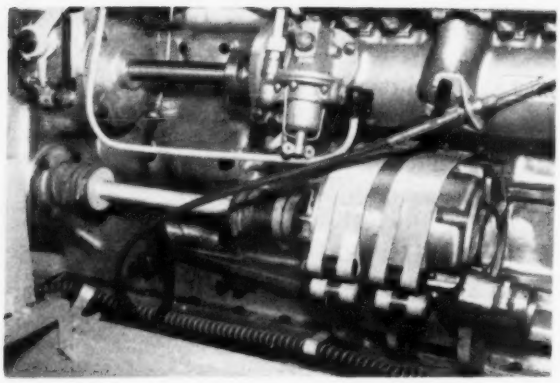
Electrical Equipment and Heaters

Rectified A.C. Systems, Sealed-Beam Lamps and Other Improvements in Lighting

IT was evident from this year's Commercial Vehicle Show that widespread adoption of the rectified a.c. system is imminent, so far as public service and other vehicles with heavy electrical loads are concerned, and that a similar change is contemplated in regard to other commercial vehicles. On many types of vehicle, the electrical loads are now so high that the dynamo, which hitherto has served the needs of commercial vehicles exceptionally well, fails to give the required output, notably at low speeds. The alternator is capable of doing this, even at idling speed. For public service vehicles, owing to the high ratio of standing to running time, satisfactory output at that speed is most desirable.

As might be expected, the rapid strides recently made with transistors have resulted in their application to the output regulation of automobile generators. Fully or partly transistorized control units were exhibited for use with rectified a.c. systems of C.A.V., Lucas, and Simms manufacture. Simms Motor Units Ltd. also displayed new designs of 4½ in diameter dynamo and starter specially developed for light vehicles.

With the object of providing improved headlighting, and thereby contributing to safer night driving, the four-headlamp arrangement is being widely applied to passenger and long-distance transport vehicles. For the same reason, it is of interest to note that the sealed headlamp unit, with its more accurately controlled light beams, is now being extensively adopted for the normal double-filament headlamp. Another useful contribution is the new C.A.V. panel warning light, with ready means for the driver to reduce the light intensity to a level suitable to his own particular need. Of interest also are the new styles of C.A.V. rear and stop lamps, and Lucas flashing type turn indicators. For coaches and public service vehicles, the C.A.V. fluorescent light unit affords an effective means of appreciably reducing the load on the battery without sacrificing light intensity, or, alternatively, of providing markedly improved interior illumination for a given electric current consumption rate.



The gear driven, C.A.V. alternator on the Guy Wulfrunian. This alternator is capable of giving maximum outputs of 29 and 35 amperes at engine idling speeds of 350 and 400 r.p.m. respectively, and its self limiting output at a maximum speed of 8,000 r.p.m. is quoted as 60 amperes

New developments on batteries mainly cover constructional changes to give longer life and easier maintenance. The application of electrical controls to automatic gear changing is exemplified by the C.A.V. and Self-Changing Gears exhibits. A noteworthy innovation for road tankers is the C.A.V. battery powered, tanker-discharge equipment, providing compact pumping arrangements independent of the main engine.

Among the new accessories are the more powerful electric windscreen wiper produced by AC-Delco for the Bedford TK trucks, and the K.L.G. heater plug, with sheathed element, manufactured by Smiths M.A. Division. To judge by the wide range of heater and air-conditioning equipment displayed, the comfort of passengers and drivers of all classes and makes of vehicle would appear to have been carefully and exhaustively studied by the various manufacturers.

New rectified a.c. systems

Introduction of these systems has been facilitated by the recent advances made in the manufacture of heavy current semi-conductor diodes capable of rectifying currents of the order of 50 amperes. In spite of the greater bulk of the well-known selenium rectifier, however, it is likely that it will for some time be preferred to the semi-conductor rectifier for heavy current systems—especially where cost is a primary consideration.

The transistor, or solid-state switching device, can, of course, be made to conduct or cut off current in an electrical circuit by the application of a small voltage to either its emitter or base. It is an attractive alternative to the electromagnetic vibratory regulator. The value of the voltage applied to the control electrode—base or emitter—determines the internal resistance of the circuit, which can be varied virtually from zero to infinity. Such a device is eminently suitable for regulating the field current of a generator, to control the output according to the desired needs.

Where, as in the partly transistorized control units, the electro-magnetic vibratory regulator is retained, it is only required to regulate a pilot circuit current, which is considerably less than that of the field circuit. The vibratory regulator is thereby relieved of the exacting duty previously imposed upon it, and consequently the contact life and durability of this component is greatly increased.

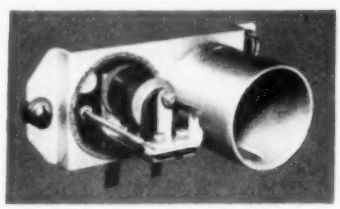
The C.A.V, 24 volt a.c. system is designed for a maximum output of 60 amperes at 27·5 volts and is intended for use on public service vehicles operating in conditions of dense traffic. This equipment comprises a 7 in diameter 12-pole alternator of the imbricated-pole design, similar in construction to the 8 in diameter unit described in the November 1958 issue of *Automobile Engineer*, a dry-plate selenium rectifier unit and a control board, of which two alternative types are available. One is provided with a conventional vibratory contact regulator and the other is a fully transistorized unit, in which a medium-power transistor in the alternator field circuit is controlled or driven on and off by a low-power amplifying transistor having a zener diode in its base circuit. The switching cycle is initiated by the breakdown of the diode, when the alternator output reaches a predetermined value.

Both control boards are identical in external appearance, size and weight. Included in each is an isolating relay, which serves to disconnect automatically the charging circuit from the battery, when the alternator is at rest. The recommended drive ratio for the alternator is between 2·3 : 1 and 2·5 : 1. With a 2·5 : 1 drive ratio, the alternator cuts in well below the engine idling speed and gives maximum outputs of 29 and 35 amperes at engine idling speeds of 350 and 400 r.p.m. respectively. The self-limiting output of the alternator at a maximum speed of 8,000 r.p.m. is 60 amperes. Although a belt drive, comprising three $\frac{1}{2}$ in wide V-belts, tensioned to between 150 and 250 lb pull, is recommended for the alternator, a gear drive is not precluded, as is exemplified by installation of the C.A.V. alternator on the Guy Wulfrunian bus.

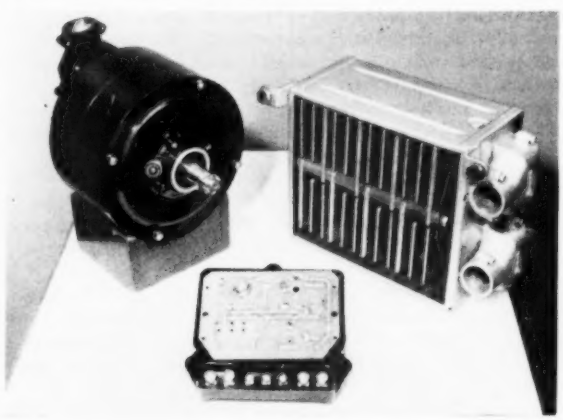
Another unit designed for heavy-duty 24-volt service, and for the usual drive ratios in the region of 2 : 1, is the Simms a.c. generator set. It comprises an 8 in diameter 8-pole alternator, a germanium diode rectifier and a fully transistorized control board. The alternator, which is of the imbricated-pole design, has an output of 40 amperes at 850 r.p.m. Since its cutting-in speed is 550 r.p.m, a satisfactory output under all conditions is assured, even with a drive ratio as low as 1·8 : 1.

The rectifier unit contains eight germanium diodes mounted on cooling fins. Six of these diodes constitute a

Lucas output control unit for their alternator, with the cover of the pilot circuit relay unit removed



Display of the Simms 8-pole alternator, the germanium diode rectifier assembly, with cooling fins, and the fully transistorized control unit. This alternator, which is of imbricated-pole design, has an output of 40 amperes at 850 r.p.m, and its cut-in speed is as low as 550 r.p.m.



three-phase bridge rectifier, and the remaining two are connected in parallel and used as blocking diodes in the control circuit. For the purpose of providing a voltage reference for current regulation, a resistance is housed in the rectifier unit. In the control unit, electro-magnetic devices are dispensed with entirely, and reliance for voltage and current regulation is placed on transistors, so there are no moving parts. The regulated voltage is set by a simple potentiometer adjustment which, once effected, requires no more attention.

For the lighter type of commercial vehicle, Joseph Lucas Ltd. has developed a 12 volt a.c. system, consisting of an 8-pole alternator with built-in rectifier, operating in conjunction with a separate control unit. The rectifier is housed within the slip-ring end bracket and comprises six silicon diode rectifiers connected to form a three-phase bridge circuit. An isolating relay is included in the system, to disconnect the alternator field and voltage regulator windings from the battery when the ignition switch is opened. The cut-in speed of the alternator is 800 r.p.m. and the maximum output builds up rapidly to 40 amperes at 2,000 r.p.m. Beyond this speed, the maximum output is limited by the stator winding reactance and cannot appreciably exceed 60 amperes, even if the alternator should be run up to 11,000 r.p.m.

The output of the alternator is controlled to suit the requirements of the battery, by means of an electro-magnetic vibratory relay, the contacts of which are in the base circuit of a transistor appropriately inserted in the alternator field circuit. Consequently, when the engine is started, the alternator voltage rises until the relay contacts open. This opening interrupts the transistor base circuit current and, because of the transistor action, the field current is considerably reduced. The consequent falling voltage output of the alternator allows the relay contacts to close again, re-establishing a high field current, which in turn results in the alternator voltage rising again. Of course, the cycle is repeated many times per second to maintain the required value of alternator voltage. This system is notably suitable for vehicles with unusually heavy electrical loading, such as those fitted with two-way radio installations. It is also suitable for delivery vans called upon to make frequent use of the starter during the normal operation of the vehicle.

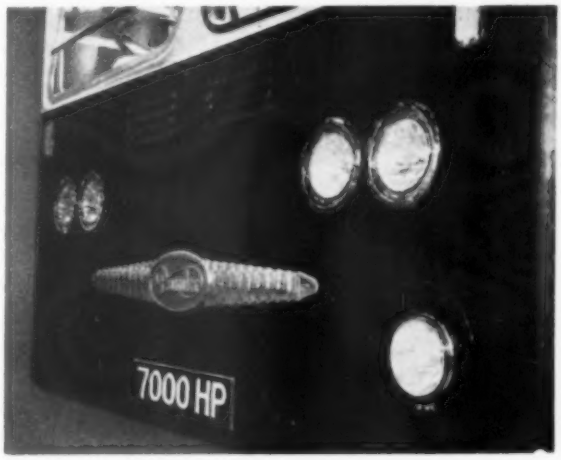
Dynamo and starter motor for light vehicles

Introduced for the first time by Simms Motor Units Ltd. are 4½ in diameter dynamos and starter motors. The dynamo, a high-output machine of the non-ventilated type, with a cut-in speed of 1,470 r.p.m, has an output of 360 watts and a weight of 21 lb. An outstanding feature of the starter motor, which is of the coaxial type, is the slowly rotating, gently engaging pinion, as distinct from the inertia engaging crash type. The switch and engagement mechanism are fully coaxial with the armature. Although this smaller model is simpler in conception than are the other units in the Simms range, it affords the same quiet and smooth engagement of the pinion and flywheel gear when starting. It has been introduced to meet the needs of the quantity-produced lighter types of commercial vehicle.

Lighting

The Lucas sealed beam headlamp unit, with integral glass reflector, first introduced some months ago, is now widely adopted. It is of interest to note that Lucas-approved units of the sealed beam type, supplied by the A.E.I. Lamp and Lighting Co. Ltd, are now available, for replacement purposes and conversions, from Mazda car bulb stockists. From test data furnished by the A.E.I. organization, it can be concluded that the sealed beam unit should last at least three times as long as the bifocal bulb it replaces.

A still further improvement in road illumination is effected by the four, or twin pair, headlamp system supplied by both the C.A.V. and the Lucas organizations. One of each pair of headlamps has a single 37½ watt filament designed exclusively to provide the major portion of the driving beam. The other lamp is a double-filament unit. A 50 watt filament is positioned at the focal point of the reflector and the optical system is designed to give the best possible meeting beam. When the main driving beam is on, the other filament of this second lamp—of 37½ watts and positioned below the meeting beam filament—provides a wider, more diffused light to illuminate the nearer portion of the road. Thus, for the main driving light, the four 37½ watt filaments are in use, giving a total of 150 watts; for the meeting beams, only the two 50 watt filaments are in operation. The extended use of this system, notably on passenger and long-distance

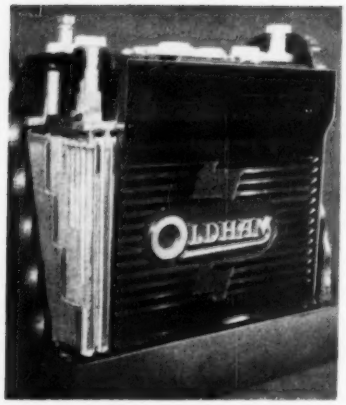


C.A.V. four headlamp system, as installed on a Daimler double-deck bus. One of each pair of lamps has a single 37½ watt filament designed exclusively to provide the major portion of the driving beam The other two lamps are double filament units: a 50 watt filament at the focal point of the reflector gives the best possible meeting beam, while the other, another 37½ watt filament, gives diffused light to supplement the main driving beam by illuminating the kerb and foreground of the road

transport vehicles, marks another step forward in providing drivers with better and safer headlighting.

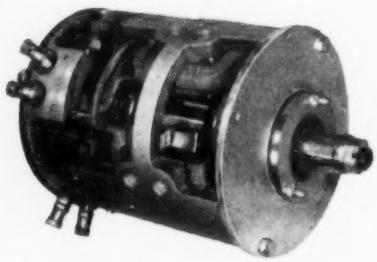
To meet the demand for flush fitting fog and long-range lamps, two new models of the CFT and CLR lamps have been added to the Lucas range. In addition, the Lucas L617 flasher indicator lamps are specially designed for commercial vehicles. Adaptable to all types of vehicles, these lamps are available in a variety of shapes for rear, front, side, and roof fitting. The new C.A.V. panel warning lamp is a neat unit that incorporates a dimming arrangement, operating on the principle of polarization of light, whereby the driver can adjust the brilliance by rotating the lamp bezel. This device consists of two polarizing discs, one fixed and the other rotatable. By turning one disc relative to the other, the amount of light passing through the discs can be gradually reduced until only a small circle of light, of about $\frac{1}{16}$ in diameter, is apparent at the centre of the window.

The installation of fluorescent interior lighting in buses and coaches can be effected with the C.A.V. type 363 light unit. The great advantage of this form of lighting is its efficiency, which permits more than a 50 per cent reduction in current consumption, as compared with tungsten filament lighting, for the same interior illumination. Alternatively, the interior illumination can be more than doubled, in its intensity, for the same current consumption.



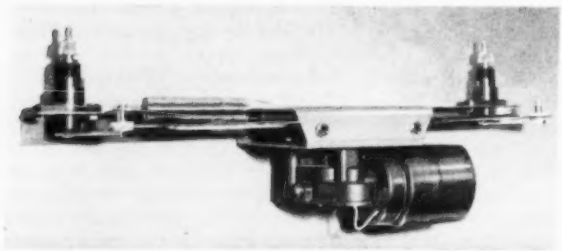
Oldham Pg double-sleeve multi-tube battery, with a section cut away to show the construction of the plates and connectors

Exide Auto-fil battery with its single filler cover swung back to reveal the porcelain balls that seal the ventilation holes



Above: The C.A.V. M274-3 motor for tanker discharge. This motor drives a centrifugal or a gear type pump, which can be installed in any convenient position on the vehicle, and which will discharge approximately 5,000 gallons of water per hour against a pressure head of 20 ft; with this load, the current consumption at 24 volts is 45 amperes

Below: AC-Delco are now producing this powerful screen wiper, with 17 in blades, for the Bedford TK truck. The twin blades sweep an area of 7 ft², which is almost the whole of the area of the windscreen



Available for 12 and 24 volt systems, the new C.A.V. fluorescent light unit converts the battery d.c. supply to the 250 volts a.c. needed for the tubes. Hitherto, rotary or vibratory inverters have been used, which not only have a limited life but also need appreciable attention in service. This new unit takes advantage of recent developments in transistors to provide an inverter with no moving parts. The resultant unit is more compact and lighter, and has a much longer life than the earlier designs.

Batteries

No strikingly apparent changes in battery design were evident, with the exception of the new Exide Auto-fil design. In this unit, the usual filler plugs are replaced by a rectangular recess joining the filler tubes of all cells, and adjacent to each tube is a small vent hole on which rests a porcelain ball. A single cover, with projections registering in the filler tubes, encloses the recess. Flanges at the top of the projections ensure that, when the cover is fitted, the balls are lifted from their seatings to provide cell ventilation. Removal of the cover for topping-up allows the balls to seal the cell vent holes and so form an air-lock. Water poured into the recess from an ordinary bottle will raise the electrolyte level in all cells until it reaches the underside of the filler tubes when, owing to the air-lock, the level in the cells can rise no further. Additional water then fills the tubes until no more can be added. On replacement of the cover, the air-locks are released and the water in the tubes passes into the cells to raise the level to the permitted maximum. The filling operation is quick and easy, and the correct level is automatically obtained.

Noteworthy features of the latest Crompton-Parkinson battery design are the tubular positive plate and specially armoured flat negative plate enclosed in micro-porous synthetic separator material. The latest Oldham battery for buses and coaches is of the well-known Pg double-sleeve multi-tube construction, and has twin-post copper-cored plate connections to copper-cored intercell connectors, thereby combining maximum mechanical strength with minimum electrical resistance. New additions to the Lucas streamlined cover battery range are the SF7, SF9 and SFL9 models, specially suitable for commercial vehicles.

Accessories

Of the new accessories exhibited, the AC-Delco 17 in blade screen wiper, specially designed for the deep one-piece curved windscreen on the latest Bedford TK truck, is worthy of comment. The blades, mounted on 18 in arms, sweep an area of 7 ft², almost the entire area of the glass, in wide overlapping arcs. To ensure efficient operation under all weather conditions, a very powerful wiper motor has been developed; it operates in conjunction with a two-stage reduction gear designed to give a high overall efficiency. The first reduction from the motor speed of 3,000 r.p.m. is a 15:1 three-start worm, and the second is a 3½:1 straight spur gear reduction: these give an overall reduction of 50:1 and a final drive speed of 60 r.p.m.

A patented balancing system, to reduce fluctuations in the motor torque requirements, is provided by a tension spring attached to the linkage rods. This spring absorbs power on the downward stroke of the blades and gives up power on the upward stroke. The blades are pivoted below the windscreen, which ensures that rain and snow are pushed downwards and outwards off the screen.

Another development of interest to road tanker fleet owners is the C.A.V. battery powered tanker-discharge pumping unit. This comprises an electric motor driving a centrifugal or gear type pump which can be installed at the rear or side of the vehicle. The centrifugal pump, powered by a C.A.V. type M274-3 motor, will deliver approximately 5,000 gallons of water per hour against a head

of 20 ft; with this load, its current consumption is 45 amperes at 24 volts. The advantages of the battery powered unit are: no need of engine power take-off arrangements, an entire absence of exhaust fumes in confined spaces, silence in operation and simple switch control. So far as initial cost is concerned, it also compares favourably with the conventional discharge system.

The K.L.G. sheathed element heater plug is a new development applicable to compression swirl type diesel engines. The enclosure of the element within an Inconel sheath protects the element from the combustion gases and the mechanical stresses arising from engine vibration. Moreover, the accommodating hole diameter for the element is small, as also is the overall diameter of the plug. In consequence, encroachment in the cooling space and combustion chamber is small. Another feature of this arrangement is that all the plugs can be connected in parallel to a 12-volt battery. As indicative of the loading, each plug takes 75 watts at 11¼ volts, and with this loading an element temperature of approximately 1,050 deg C is attained.

Electrical controls for transmissions

In the past two years good progress has been made in the design and application of electrical control to fully automatic transmission systems, which are now being extensively applied, especially on public service vehicles. Apart from its benefits in respect of fuel economy and smoother gear changing, fully automatic transmission has the great advantage of simplifying driving technique and relieving drivers of physical and mental strain.

Good examples of this form of control are the C.A.V. and the Self-Changing Gears systems. In both of them, the basic components are a selector unit—usually mounted on the steering column—whereby the driver can exercise control over the system for automatic or manual operation, a speed-sensitive generator and a throttle switch, which relate the control to road speed and engine torque, a control panel whereby the electrical signals from the speed and torque sensing devices are translated into the required gear changing actions, and an electro-magnetically actuated valve unit which, by pneumatic or hydraulic pressure, engages the gear ratio appropriate for the engine operating conditions.

The signals from the sensing devices operate voltage-sensitive relays which, in turn, control switching relays, the contacts of which close the appropriate solenoid circuit to effect the required gear change. Over the past few years considerable experience has been gained with electrical control systems and the current designs can be relied upon to give long and satisfactory service.

Heating and air conditioning

New exhibits noted under this heading were the Smiths M.A. Division canopy heater and F370 transport vehicle cab heater, the Spherevent air control and thermostatically controlled metering water valve and, among the Key-Leather products, the Norway design of cab heater for commercial vehicles. Designed for fitting between the body panels, above the open area to the left of the driver, on double-deck passenger vehicles, the Smiths canopy heater operates as a fresh-air type unit, the warmed air being ducted to louvres in the upper and lower saloons. Two blower units within the heater casing deliver air at the rate of 400 ft^3/min, with a nominal heat output equivalent to 14 kW at 150 deg F temperature difference. This unit can also be used in warm weather for the circulation of cool fresh air.

The new F370 fresh-air cab heater has a heat output equivalent to 3¾ kW. An important feature of this design is that it is fitted with a detachable motor-plate, enabling speedy servicing of the motor and fan to be effected without the necessity of dismantling the complete heater unit. Provision is also made for the operation of the unit as a recirculation heater whenever this arrangement is desired.

Demonstration of the Spherevent air control, which is especially suitable for coaches and ambulances, fully confirmed the claims for air direction effectively through 360 deg around its periphery and 180 deg to the plane of the vent face. This desirable feature is obtained by virtue of a built-in deflection vane, which renders it possible to provide an air stream virtually parallel to the vent face. The manually operated metering water valve assembly comprises a quadrant type temperature control coupled by a flexible operating cable to a thermostatic valve. Working on the fluid expansion principle, the thermostatic unit consists of a valve, the opening position of which is determined by the quadrant control, which applies pressure through a spring attached to a temperature sensitive capsule. This permits an optimum valve setting, to allow a pre-set delivery of the engine coolant water to the heater matrix.

A sensing element from the capsule, placed in the air stream from the heater matrix, allows for further control of the valve by expansion or contraction of the capsule, under the influence of temperature fluctuation caused by varying road conditions, around the datum setting of the quadrant control. For a given setting of this control, the temperature-sensitive capsule, by regulating the water flow, will maintain a constant heater air outlet temperature irrespective of temperature fluctuations with engine load.

For application to the Bedford TK truck cab, the K-L Norway heater-demister and defroster unit, has been redesigned to provide adjustable demister ports. It is equipped with a push-pull motor control, and operates in conjunction with the Bedford fresh-air ventilation control. An alternative model with its own fresh-air intake is available for the 4D vehicle made by the Ford Motor Co., Ltd.

This is the rear end of the Willowbrook Viscount Mk I luxury coach, which is one of those with fluorescent lighting for the saloon interior. Another noteworthy feature is the arrangement of the raked rear window

The Dennis Vendor van, with some of its panels removed to show its construction. Noteworthy features are the side door and the low height of the large flat floor

Bodywork

Reinforced Plastics More Widely Used; Examples of Mechanical Handling Equipment Installed in Vehicles, for Loading and Unloading Goods

A STUDY of the exhibits disclosed an overall trend towards constructional improvement and the widespread use of new methods. There were many forms of construction, including the familiar composite type, all metal, all plastics, and integral structures, as well as combinations of two or more of these. Each manufacturer has explored the possibilities of new materials and new details of construction, all of which have their particular merits. Although more thought has been given to the comfort of drivers and crews, there is still considerable scope for improvement on the long-haul, heavier types of transport.

It will be appreciated that the development of new methods of body building can be much facilitated by consultation between the manufacturer and operator. The benefits of co-operation of this type were revealed by certain of the vehicles shown at Earls Court. There is increasing emphasis on providing a low loading platform with a flat floor, and the numerous examples of this tendency included coaches, double-deck buses and goods transport vehicles. With regard to box vans, a considerable amount of thought has been given to pallet carrying and loading; and there is a variety of roller conveyors and special equipment, for stacking inside the van.

Various painting systems are in use. Air-drying synthetic enamels are the most widely used, but high-bake synthetics are preferred for the light, quantity produced types of van. In the case of one covered van body, made of glass reinforced plastics, the two colours employed were embodied in the resin. It was noticeable that some exhibitors painted all their models in the same colours, giving a very pleasing effect. This was not always possible, however, since many vehicles had to be finished in the house colour schemes of the customers concerned, the results sometimes being scarcely aesthetic.

A feature of the Show was the wide variety of trimming materials used, in many cases with excellent results. The popularity of p.v.c. materials has increased, and it was noteworthy that manufacturers are experimenting with the so-called breathing types. These give ventilation to the cushions and prevent the clinging effect experienced with the normal p.v.c. coatings.

Mickleover Transport Ltd. showed a good example of a reinforced plastics box van on the Karrier Bantam 2-3 ton chassis. This body is 11 ft 9 in long × 6 ft 6 in wide × 6 ft 6 in high; it weighs 12½ cwt and has three-door loading. The shell is moulded in one piece and is reinforced where necessary by integral ribs. A double-skin system is employed, with a foamed plastics core, and the wall thickness is ⅜ in. Pigmented resin is employed for the gell coat of the outside skin, and on this coat the layers of glass and resin are built up. Then the framed core, in slab form, is applied and the inner skin of glass and resin is laid up on it.

The floor is 1 in thick and has a non-slip surface; to its underside are bonded the wooden bearers for attachment to the chassis. Each of the three doors is of the roller shutter type, also made entirely from reinforced plastics material, without metal reinforcement. The lower part of the body exhibited was red and the upper part cream; an excellent finish and consistency of colour had been achieved.

Thompson Bros. (Bilston) Ltd. have produced the Autotanker for B.P. This vehicle, intended for long-haul work at high speed on motorways, is of very interesting design in that the engine is at the rear and is attached to the lower part of the structure, which is of the integral type. The tank is of aluminium, argon arc welded, and has been made very rigid by the addition of box-section longitudinal beams at the top and bottom. It has six compartments, giving a total capacity of 4,000 gals. The main loads are taken by the compartment divisions, which are reinforced with box-section stiffeners.

All the pipe-work and tank outlets are concealed by the attractively styled outer skin. This outer skin is in two portions, the upper of which forms the roof panel, as far as the drip line, where it is secured to the skin of the tank itself. The lower portion, which forms an apron, starts at the waist

line—where it is secured to the tank skin—and continues down to the bottom line of the body. Considerable care has been taken to blend the 16 s.w.g. aluminium outer skin into the tank form: it is bonded to the tank with an Araldite synthetic resin adhesive.

The cab of the Autotanker is unusual in having its entrance door in the front panel, below the large wrap-round windscreen. As a safety measure, there is a hatch in the roof of the cab, access to which is gained by means of a Jacob's ladder; in addition, the side windows are large enough for emergency exit purposes. Leveroll level-ride seats are provided for the driver and mate. This type of seat is adjustable, to suit the weight of the occupant, by a control comprising a system of links and levers, and rubber torsion springs. Another item of interest on this vehicle is the provision of a Barr and Stroud prismatic rear view mirror which sights along the interior of the catwalk structure to give a good field of view directly to the rear.

A triple-purpose pallet van, mounted on an E.R.F. 8-wheel chassis, has been built by Cockers of Southport. It is constructed of wood, with steel reinforcement, and has exterior and interior panelling of aluminium alloy and resin-bonded plywood respectively. Between the outer and inner panelling is sandwiched a 2 in layer of Polyzote insulation. The exterior of the model exhibited was painted in air-drying synthetic enamel.

A roller floor of patented design is installed. Two sets of rollers are situated one on each side of the longitudinal centre line of the floor, about 9 in apart, and between them are fitted wooden floor boards. These boards are linked, in groups, to levers mounted on the outside of the vehicle; operation of a lever causes the appropriate section of the floor to be moved upwards to take the load off the rollers. The reason for having the floor in sections is that it enables any particular pallet to be secured or released as desired. A second pallet deck can be fitted above the first. It consists of two sets of light alloy channels carrying rollers: cleats are used to attach the outboard channels to the body sides, and the inboard channels are supported by removable tubular pillars. The van is 24 ft 6 in long × 8 ft 0 in wide × 8 ft 6 in high, and can contain 24 pallets measuring 48 × 40 in.

One of the latest products of the York Trailer Co. Ltd. is a semi-trailer which, to save weight, is of chassisless construction. All the framing is of aluminium, and it is fitted with corrugated sheeting of high-tensile aluminium. The flooring is of 1 in thick hardwood, laid longitudinally on high-tensile pressed steel cross members spaced 12 in apart. This vehicle is designed for loading and unloading by fork lift trucks, but pallets can be handled by means of a pair of portable roller tracks of a special type. The roller spindles are connected by a system of rollers and cams to an actuating hand lever. Movement of the load is initiated by moving the handle to and fro. With this arrangement movement of the load is effected by its own weight so the manual effort required is small.

A new and logical approach has been made by the Pressed Steel Co. Ltd. to the problem of transporting goods by both road and rail. Its result is the Roadrailer vehicle, shown to the public for the first time at Earls Court. The Roadrailer combines the two functions of a semi-trailer for road use and a railway freight carrier for fast goods trains, and the aim behind the design is to put the railways on equal terms with road transport for long-distance heavy hauls.

This vehicle has a van body 24 ft 7½ in long × 8 ft wide × 8 ft 2 in high, giving a load-carrying capacity of 1,400 ft³. It is capable of transporting 11 tons of freight, with an all-up gross weight of 16 tons. Unitary construction is employed, and the underframe is arc-welded Cor-Ten high-tensile steel. The structure consists of side sills and cross members, which are free to pivot around a central 5½ in diameter continuous draw-bar tube fixed at the rear headstock. For minimum weight, the body is constructed of aluminium alloy; it is a stressed skin structure integral with the underframe portion.

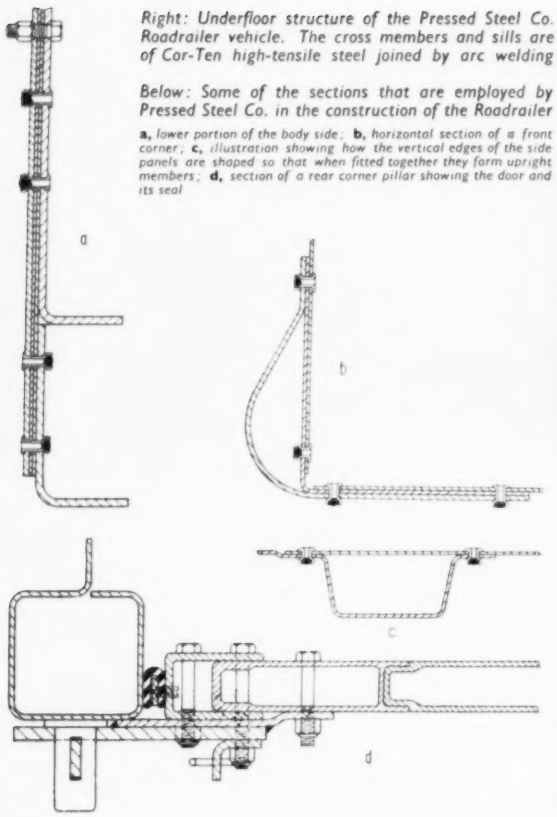
The rear pillars of the body are 3 in × 3¾ in × ⅛ in aluminium alloy box-section extrusions, and a special extruded section is employed also for the cant rails. One vertical edge of each panel is formed into a channel, which overlaps the plain edge of the next panel to form a box section. The whole body structure is blind riveted. For the floor, an extruded aluminium section, 1½ in deep, is used; the floor members run the full length of the body and are bolted to the cross members of the underframe unit.

There has long been a need in this country for a miniature delivery van. Such a van, of 5 cwt capacity, has now been introduced by B.M.C, in Austin and Morris versions. Since it has a lively performance and is easy to park and cheap to operate, it should quickly find its place for light delivery work in congested areas. Not the least of its good points is its attractive and perky appearance, which lends itself well to the adoption of a gay colour scheme.

This little van is of all-steel construction and its design is based on that of the highly successful ADO 15 car; the front end is virtually identical with that of the car, but the longer wheelbase and floor, necessary to obtain the desired capacity of 58 ft³, has given the van an overall length that is greater by more than 9 in. Even so, the length is only 10 ft 9⅞ in; the overall width is 4 ft 7½ in and, because of the front wheel drive, the loading height of the floor is only 18 in. According

Arrangement of the handling pallets and rollers in the Cocker pallet van. The upper platform can easily be removed if necessary

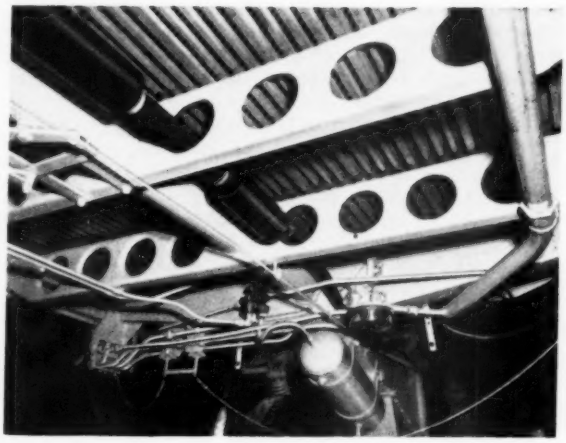
Autotanker, produced by Thompson Bros. (Bilston) Ltd. for B.P. This vehicle is unusual in having its entrance in the front panel and an escape hatch, for use in the event of an emergency, in the roof of the cab



Right: Underfloor structure of the Pressed Steel Co. Roadrailer vehicle. The cross members and sills are of Car-Ten high-tensile steel joined by arc welding

Below: Some of the sections that are employed by Pressed Steel Co. in the construction of the Roadrailer

a, *lower portion of the body side;* **b,** *horizontal section of a front corner;* **c,** *illustration showing how the vertical edges of the side panels are shaped so that when fitted together they form upright members;* **d,** *section of a rear corner pillar showing the door and its seal*



Below: Martin Walter have produced this mobile shop on a Thames 15 cwt chassis. Although standard components are largely used for the body, additional interior height is gained by the employment of a special domed roof of glass reinforced plastics. This view shows the wide transverse counter at the back, and the space for customers immediately behind it; the lockers that can be seen on each side form seats for the customers to use while they are waiting to be served. Access to the interior is gained by means of the step below the rear sill

to the makers, the unladen weight is 12 cwt, which is less than 20 lb higher than that of the car.

Karrier Motors Ltd. exhibited a very smart, ice cream van, with forward control, on the 2 to 3 ton Bantam chassis. The bodywork was built by M.T.S. and Co. (Coachbuilders) Ltd. and is panelled in aluminium. Features of this vehicle include a side entrance and a counter that provides built-in accommodation for the equipment for dealing with soft ice cream. The counter top is covered in a decorative plastics laminate, of the melamine-faced phenolic type, having a check pattern; a roof lining of peg-board is employed to provide a degree of sound absorption.

Slung under the body, alongside one of the side members of the chassis frame, is a generator that provides power for the two-temperature refrigerator. In this refrigerator are two ice cream conservators: one is maintained at —10 deg F, for storing the "lolly" type of product, and the other is kept at 30 deg F, the correct temperature of the ice cream mix. Conveniently placed inside the vehicle is a soft ice cream dispenser, the delivery end of which is held at —25 deg F.

The driver's seat is a Chapman three-way unit, adopted because it provides easy access to the shop portion through a door immediately to the rear of it. Both the external and internal decoration of the example shown were tastefully carried out. The driving mirrors are unusually large and are anchored to the doors at two widely spaced points, to reduce the likelihood of damage and maladjustment.

Another mobile shop was that exhibited by Martin Walter Ltd, on a Thames 15 cwt chassis. This is an interesting layout in that, although the body is largely a standard production, the inside height of 6 ft 2 in is gained by fitting a high domed roof, of glass reinforced plastics, in place of the normal roof. The rear compartment of the vehicle is equipped with shelves and counters; at the back, behind a wide transverse counter, is a standing space for customers inside the rear entrance. Included in the equipment are two lockers on each side, which form seating accommodation. The counter tops and body linings are of washable plastics materials.

Mention should be made of the Britannia luxury coach exhibited by Duple Motor Bodies Ltd, who, of course, are specialists in this type of vehicle. This body, which is mounted on an A.E.C. chassis, normally carries 32 passengers and has a central sliding door entrance. It is of composite construction, the hardwood framing having steel and aluminium alloy reinforcements. For most of the panelling, aluminium of 16 and 18 s.w.g. is employed, but Zintec steel sheet is used for the rear corner panels.

A noteworthy feature is the double-curvature windscreen, of toughened safety glass: it comprises three parts—a wide middle panel and two wrap-round quarter panels. This

windscreen, which was probably the largest with double curvature to be seen at the Show, plays its part in the harmonious front-end appearance that has been achieved. For maximum comfort, the seating design and layout follow aircraft lines: the seats themselves, which are trimmed in moquette, are of the adjustable bench type, and are fitted with adjustable footrests and folding tables. To give the passengers the best possible field of vision, the parcels racks are mounted on the body headrails. An alternative seating layout is available on this model, to increase the accommodation to 41 passengers.

Among the firms who have given close attention to the need for greater driver comfort are Leyland Motors Ltd. The Company's latest cab, known as Vista Vue, is mounted as standard equipment on the Comet, Super Comet, Octopus and Beaver chassis. It is an all-steel unit of double-skin construction, and has a steel frame fabricated from box-section members. The door aperture frame is a one-piece pressing, thereby eliminating corner joints. At the cab mounting points, rubber bushes are interposed between the structure and the chassis frame. Glass fibre is used in the roof for insulating purposes.

All the underparts of the cab structure, including the wings, are coated during manufacture with a thick rubberized sealing material. Similar treatment is given to the inside faces of the door panels. The full-length doors are hinged at their front edges, and the height of the lower step from the ground is 20 in.

An alternative cab, with moulded, glass reinforced polyester resin panels, is offered by Leyland Motors. Although in this case, the mouldings replace the pressed steel panels of the standard cab, the steel frame structure is common to both. The moulded cab therefore has the same external appearance as the other but is approximately 2 cwt lighter.

A front entrance, double-deck bus exhibited by Park Royal Vehicles Ltd. is of unusual interest. This is the Bridgemaster, a 72-seat vehicle with an all-metal body of unitary construction and equipped with A.E.C. mechanical components. Its overall dimensions are 30 ft long × 8 ft wide × 13 ft 5⅜ in high. Seating accommodation is provided for 29 passengers in the lower saloon and 43 in the upper; both saloons have a full-length centre gangway.

The main structure of the body is of steel, and it embodies full-depth truss panels riveted in position. In the entrance are jack-knife type doors, operated by the driver, and the spiral staircase is attached to the off-side of the body behind the cab. The floor of the lower saloon is constructed of light alloy and mild steel sections, to which high-duty light alloy panelling of heavy gauge is riveted. A single piece of resin-bonded plywood comprises the floor of the upper saloon. The front and rear dome panels of the body are glass reinforced plastics mouldings, but all the other panelling is of aluminium. All external main panels are blind riveted in position, and the joints of the roof panels are all secured by solid riveting.

Weymann's Ltd. has produced a single-deck bus, for Edinburgh Corporation, intended strictly as a utilitarian model for short routes. The body, which is mounted on a Leyland Tiger Cub chassis with underfloor engine, has an overall length and width of 30 ft and 8 ft respectively; its seating capacity is 47 passengers. All-steel construction is employed, and the main floor bearers are of back-to-back channel section, with timber inserts for attaching the floor.

These two illustrations are of the B.M.C. Mini-Van. This vehicle, which has a load carrying capacity of 5 cwt, is of all steel construction, and its design is based on that of the very successful ADO 15 car

The body pillars are of top hat section, and the exterior panels are riveted to them. As on the Bridgemaster, the front and rear dome panels are polyester-glass mouldings. There is no inside panelling, except for the roof, which is of the double skinned type. A deep, channel-section truss stiffens each side: the upper flange of the truss serves as an anchorage for the seat fixing, and the lower one does a similar duty for the side of the floor. Resin bonded plywood, again, is used for the floor, which is covered with abrasion resistant p.v.c. sheet material. All the passenger seats face forward and have tubular frames, the top rails of which are stainless steel.

A typically Continental type of side entrance bus was shown by Klöckner-Humboldt-Deutz AG: it was the Magirus Deutz Saturn II bus, for city work. For such duties, the use of two side entrances is undoubtedly an advantage, since entering passengers are not hampered by those trying to leave the bus at the same time. Unitary construction is employed for the body, both the framing and outside panelling of which is of steel. The inside of the roof, though, is panelled in aluminium, the curved panels being perforated to promote air circulation between them and also to facilitate absorption of noise. Normally, the accommodation is for 32 sitting passengers, in single seats, and 52 standing. However, for peak traffic hours the standing accommodation can be increased to 72, thus enabling 100 passengers to be carried.

A service bus for one-man operation was on the stand of Willowbrook Ltd; it was on an A.E.C. Reliance chassis. This version is a standard 42-seat bus of lightweight construction with metal framing and glass reinforced plastics moulded front and rear ends. The doors for the front entrance and central exit are electrically operated from the cab, which is fitted with a change counter and ticket machine.

Another Willowbrook product exhibited was a 41-seat luxury coach, also on an A.E.C. Reliance chassis. The body of this vehicle also is of the company's standard lightweight construction, with metal framing, but the seating is more

The Duple Britannia luxury coach on an A.E.C. chassis has a double curvature windscreen of toughened safety glass: it comprises a wide central panel and two wrap-round quarters, separated by slender pillars

luxurious. In comparison with the bus just mentioned, this coach has more modern styling of the rear end, by virtue of a raked rear light.

The A.E.C. Reliance chassis formed the basis of yet another coach, the 34-seat Seagull 70 touring model built by H. V. Burlingham Ltd. Steel body pillars of standard section are employed, and incorporate timber battens to facilitate attachment of the exterior panels. The body has a front entrance, in which is fitted a single-panel hinged door providing easy access. Transparent panelling is used for the mid-portion of the roof, where there are four Weathershields lift-up panels of the three-way type, and panels of the same material are fitted in the front and rear domes. The side panels of the roof are glazed with Sundym glass, four panes on each side. Comprehensive heating and ventilating equipment is a feature of this body, and the fresh air intake is in the front panel, between the two destination indicator boards. The seating accommodation is of pleasing appearance and is very comfortable: each seat is fitted with a Chapman four-position adjustable squab and a foot rest. Moquette is used for the seat trimming, in combination with hide facings, and the side lining panels are trimmed with Vyweld material. The parcels racks, of the inslung type, have a nylon mesh base, and their aluminium frames are finished by silver anodizing.

Two versions of the Embassy 41-passenger coach were exhibited by Plaxtons (Scarborough) Ltd; one of these was mounted on a Leyland Leopard chassis, and the other on a Bedford S.B.1. chassis. An outstanding feature of these vehicles is the use of Vitaweb resilient platforms for the seat cushions, in the interest of improved seating comfort. It is claimed that these platforms are very effective in absorbing road shock, besides giving a degree of compensation for different weights of occupants. Each platform consists of a sheet of high-tensile rubber, $\frac{3}{32}$ in thick, suspended from the seat base by six hooks which are bonded in position during the moulding operation. To permit air circulation, large holes are embodied in the rubber sheet. This design is

Right: Interior of the Burlingham Seagull 34-seat touring coach. Four Weathershields, three-way lift-up panels are embodied along the centre of the roof, the sides of which are glazed with Sundym glass. Clear Perspex panels are fitted in the front and rear domes of the vehicle

claimed to allow thinner foam cushions to be used than does the conventional type of platform.

To demonstrate the uses of its new extruded snap-section panelling, The British Aluminium Co. Ltd. exhibited a partly built-up van body. This interesting component, which is an extrusion, combines the panel and a reinforcing pillar; adjoining sections are interlocked by means of a series of projections from the reinforcing portion. No rivets or bolts are necessary to effect the joint but it is suggested that the mating surfaces be sealed with an Araldite compound.

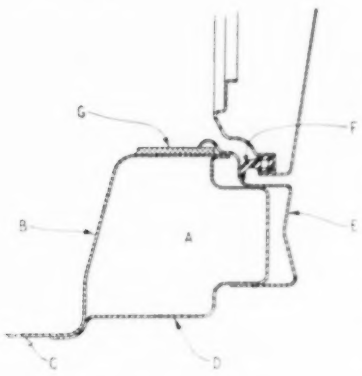
CURRENT PATENTS

A REVIEW OF RECENT AUTOMOBILE SPECIFICATIONS

Body sill construction

Modern body constructions are provided with essentially smooth or plane surfaces and the greatest width is commonly disposed approximately at the level of the driver's elbow. The unprotected region intermediate the front and rear wheels is likely to be exposed to water and mud thrown up by the front wheels. The sill construction proposed is designed to screen the body and door surfaces and prevent them becoming soiled in operation.

The sill is formed by a longitudinal bearer member A consisting of part B, preferably integral with the vehicle floor pressing C, and part D attached by welding. On its outer face, member A is furnished with a channel-section decorative strip E fitted over a corresponding channel, pressed out of part D, and secured by welding. The web portion of strip E is pressed inwardly to a vee-section; the upper part at 8 deg and the lower part at 15 deg, for example. In this manner, the door gap and the adjacent portion of the door is screened from the impact of water and road debris.

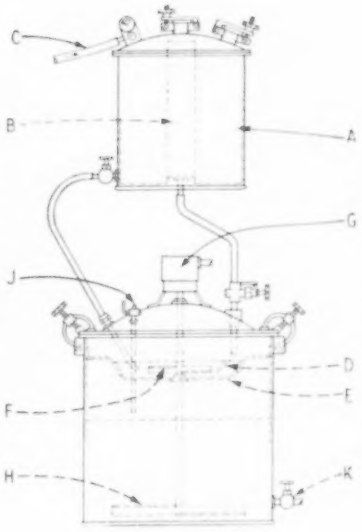


No. 849404

By suitable configuration, the upper flange of strip E serves to cover the junction flanges of parts B and D and form an abutment face for the sealing strip F carried by the door. At its free margin, the upper flange of strip E extends into the passenger compartment and is beaded to overlie and secure resiliently the floor covering G. *Patent No.* 849404. *F. Porsche (Germany).*

Blending and dispensing fluids

Where certain fluids are to be blended it is essential that mixture is effected only a short time before being used. A particular instance is the use of acid catalysts in lacquers and enamels. As soon as the catalyst is added the mixture commences to harden and consequently it cannot be stored for future use. Mixing manually immediately prior to use is time-absorbing, is unlikely to produce consistently a homogeneous mix, and is liable to be wasteful of materials. The invention proposes a method and equipment to ensure



No. 849621

a thorough and intimate mixing, and automatically to prevent the quantity of the mixture exceeding a predetermined amount.

The method consists of feeding two or more fluids under pressure into a chamber having a primary mixing zone located above a main mixing zone. From the primary zone the mixed fluids overflow to the main zone, from which the homogeneous mixture is extracted. Feed pressure and the pressure in the main zone are maintained constant so that the pre-set quantity of mixture in the main zone cannot be exceeded.

Shown diagrammatically, the apparatus comprises a supply pressure pot having a main container A for lacquer and an inner compartment B for the catalyst, both subjected to the same pressure of 10-12 lb/in^2 from an air line C. Pipe lines feed lacquer and catalyst respectively to a lower mixing chamber and deliver through spray jets D to a reservoir-type tray E. Suitable valves in the pipe lines enable the mixture ratio to be regulated about the normal of 4:1 lacquer and catalyst; a micrometer flow valve is provided for accurate adjustment of the catalyst flow.

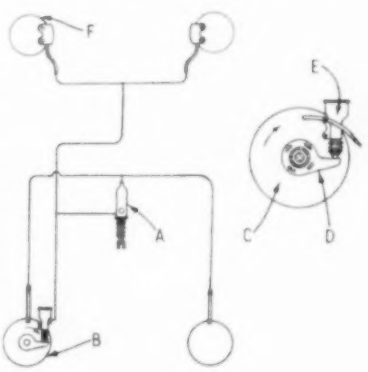
In tray E the fluids are mixed by an agitator F driven by air motor G, and from there the mix flows over into the main chamber where it is stirred by a further agitator paddle H. Delivery to a spray gun is by way of outlet valve K, located at the base of the chamber.

When commencing operation, an air release valve J on a vent pipe is held open until mixture reaches the lower end of the vent pipe and appears at the outlet, and is then closed. This is the means by which the level of the mixture in the main chamber is limited. As soon as the pressure of the air in the mixing chamber is raised to balance the feed pressure, the flow of unmixed fluids will cease until mixture is drawn off and the level falls. *Patent No.* 849621. *C. W. Loftus.*

Servo-assisted hydraulic brakes

A prime object of this system is to ensure the maintenance of the pressure differential existing normally between front-wheel and rear-wheel brakes of a vehicle despite any possible variation in their respective efficiencies. It is characteristic of disc brakes that they are less susceptible to fade under prolonged use than are drum brakes. Thus, in a common arrangement involving disc brakes at the front and drum brakes at the rear of a vehicle, fading of the drum brakes will be likely to result in a change in the braking ratio and may endanger safety. While particularly suitable in such combination arrangements, the proposed system is desirably applicable to all-disc or all-drum braking layouts.

The pedal-operated, servo-assisted, master cylinder A is connected to actuate both drum-type rear brakes B. On one of these brakes, as shown in detail, the back plate C is not fixedly mounted but is permitted a limited angular movement in relation to a torque bracket D secured to the axle casing. A servo-cylinder E is

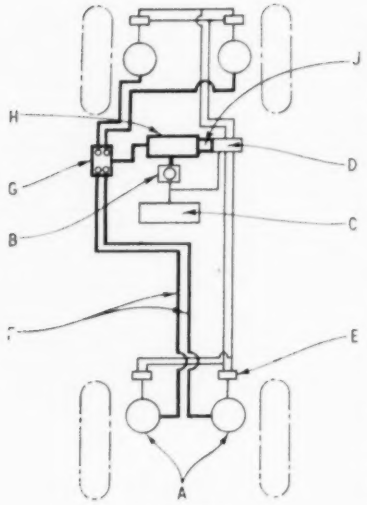


No. 849625

attached directly to the back plate, so that when the plate moves on application of braking pressure the end of the servo piston rod is displaced by contact with bracket D. Servo pressure is utilized to actuate the two disc brakes F at the front of the vehicle and also to boost the master cylinder A. Thus, should the rear brakes fade, the lessened torque applied to the back plate will reduce the operative effect of the servo-cylinder and pressure in the disc brakes will be proportionately reduced. *Patent No.* 849625. *Dunlop Rubber Co. Ltd.*

Wheel changing on vehicles with pneumatic suspension

On a vehicle equipped with pneumatic suspension of the rubber-bellows type, wheel changing is facilitated by arrangements to isolate the individual pneumatic spring, release the pressure to atmosphere, draw off air to establish a partial vacuum, and thus collapse the bellows and raise the wheel out of contact with the road surface.



No. 849769

Referring to the suspension layout diagram, A are the bellows springs, B is an air compressor driven either from the vehicle power unit or by an electric motor, C a compressed air reservoir, D the main valve regulating the compressor delivery, and E are level-regulating valves. These components represent the normal installation.

To enable an individual road wheel to be raised when wheel changing, additional equipment is required. This comprises conduits F connecting individual bellows to a valved, selective control device G, and a vessel H provided with an inlet closable by means of a valve J. The vessel H is in communication with control device G and the suction side of air compressor B. In normal operation the compressor draws air from atmosphere through vessel H.

When it is desired to lift a wheel, the associated spring is put into communication with vessel H by operation of control device G which also, by electrical means, starts up the air compressor. The coupled valves D and J are closed, and suction is applied to the suspension spring raising the wheel and its suspension arm or wishbone, and sustaining them as long as the suction is maintained. On the completion of the wheel-change operation, return of the control G to its initial position closes the appropriate conduit F, valves D and J are opened, the spring is recharged, and the wheel is brought to the road again.

It is, of course, necessary for the vehicle body or chassis to be supported adjacent to the wheel before the spring is evacuated. Instead of using a temporary or an improvised means, supporting struts may be articulated on the chassis and each arranged to be moved automatically from rest to a support position when the selector device G is operated. Such struts may be provided with abutments to limit the subsequent upward movement of the road wheel. *Patent No.* 849769. *Daimler-Benz AG. (Germany).*

Hydrodynamic braking system

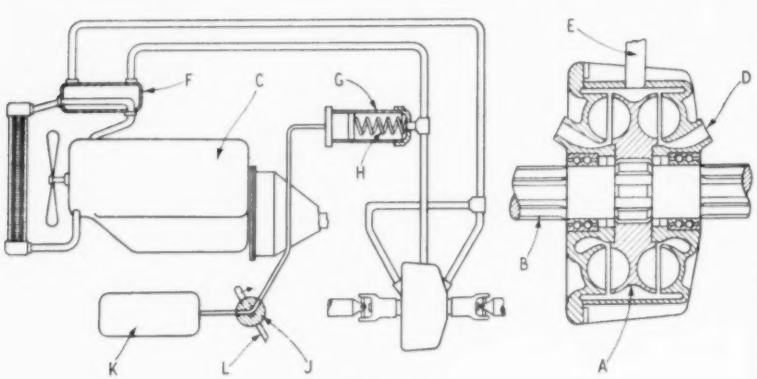
In recent years, various schemes have been advanced for the application of relatively small hydrodynamic brakes, such as are used in dynamometers, to heavy transport vehicles. This invention propounds an extremely simple system that eliminates the usual hydraulic circulating pump. The hydraulic fluid—lubricating oil is suggested—circulates in a closed system furnished with a spring-biased, variable-capacity reservoir of a maximum capacity about, or somewhat greater than, that of the hydrodynamic brake. In normal running, therefore, fluid is withdrawn from the circulation system and the brake can rotate without appreciable braking effect.

The brake is applied by the admission of compressed air to the opposite side of the reservoir piston, which overcomes the constraint of the spring and forces the stored fluid into the circulating system to fill the brake. Control is by a single lever actuating a simple, two-way valve. To terminate braking, appropriate movement of the valve shuts off the compressed air accumulator and releases the air in the reservoir to atmosphere. Immediately, the spring moves the piston of the reservoir and fluid is withdrawn from the circulating system.

Of straightforward design with a single, duplex-vaned rotor A running between two stator members, the brake is mounted on the vehicle framing. The brake shaft B forms an intermediate element in the main transmission line and is in driving connection, possibly through universal joints, with the power unit C and the propeller shaft. Fluid enters the brake by two inlets D at the hub and leaves through a single outlet E in the periphery. Operation of a hydrodynamic brake transforms kinetic energy in the shaft into heat in the fluid, and this heat must be withdrawn from the system. Usually, the unit is jacketed and a special cooling system is provided, but in this invention the braking fluid serves as the cooling medium.

On leaving the brake unit, the fluid passes through a heat exchanger F and gives up heat to the otherwise conventional cooling system of the engine C. Coolant leaving the engine cylinder jackets passes through the exchanger before reaching the radiator. This arrangement is claimed to be of particular value. As the brake will be most used in descending long down grades, when the engine is running light and liable to become over-cooled, the heat added to the coolant system will maintain the temperature of the power unit at a relatively high optimum value.

In open communication with the delivery line from the brake unit, the cylindrical reservoir G has a piston which is normally moved towards the head cover by a spring H, thus withdrawing fluid from circulation. To actuate the brake, valve J is operated to admit air from a pressure accumulator K to the head of the fluid reservoir, displacing the piston against the spring H and forcing fluid into circulation. The brake is released by operating valve J to cut off accumulator K and vent the reservoir to atmosphere by way of outlet L. In either case, brake response is immediate and the application can be controlled suddenly or gradually as required. *Patent No.* 849529. *Thompson Products, Inc. (U.S.A.).*



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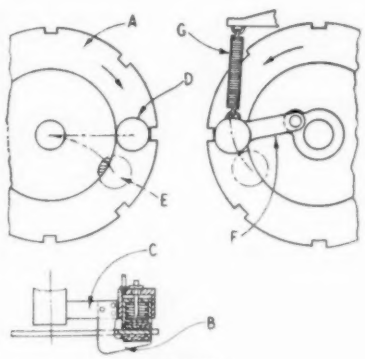


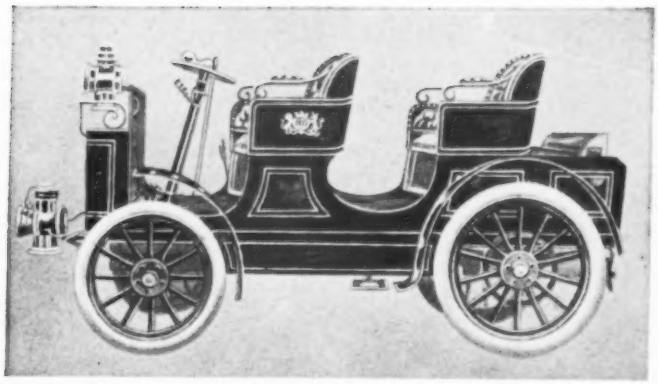
No. 850053

Disc brake torque control

Although primarily intended for the disc brakes fitted to aircraft landing wheels, this method of automatically controlling brake torque to give smooth and uniform braking, and to prevent excessive braking, is likely to be of interest in other applications. In the diagrams, the rotatable disc A is of the aircraft type and is driven from the periphery. Embracing the disc is the caliper member B carrying the hydraulic brake cylinder and the friction pads in the usual manner.

The caliper is supported from the axle casing on a cantilevered leaf spring C that, when the brake is released, carries the brake unit in position D. On the application of braking pressure a torque is exerted which causes the spring C to be deflected in the direction of disc rotation. With the bending of the spring, the radial position of the brake unit relative to the disc axis is shortened and the contact area of the friction pads is lessened, as shown at E. These two factors result in a reduction of torque and tend to maintain approximately uniform brake torque.

An alternative arrangement shows the brake unit mounted on a pivoted lever F and supported by tension spring G. *Patent No.* 850053. *The Goodyear Tire and Rubber Co. (U.S.A.).*



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		AB	C	D	D2E
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Percentage who had a motor car	34%	70%	43%	26%	17%

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* These figures are quoted from the London Viewership Survey No. 3,
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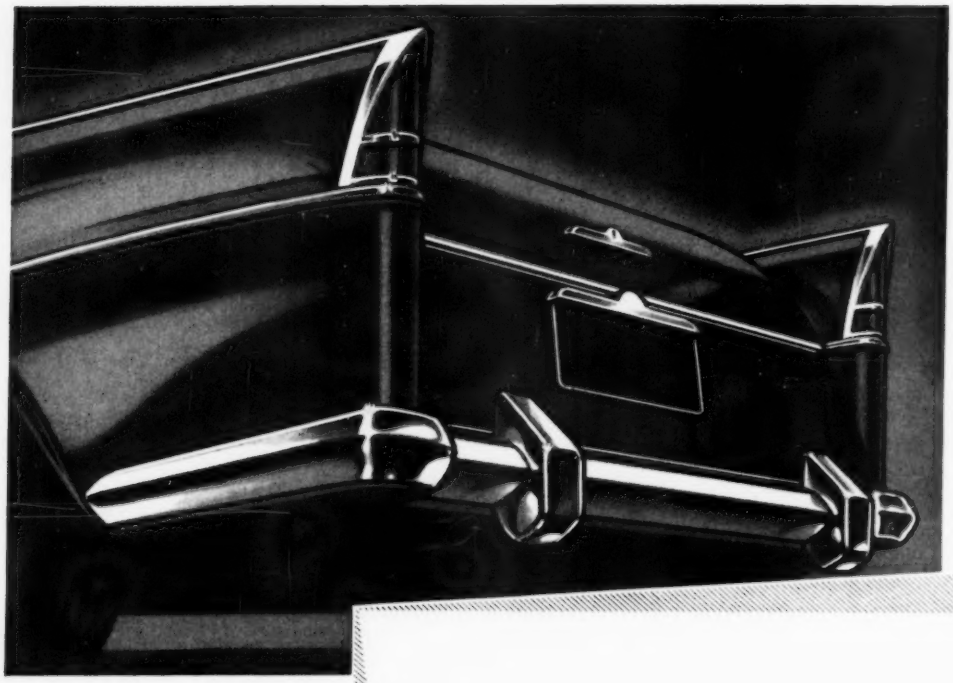

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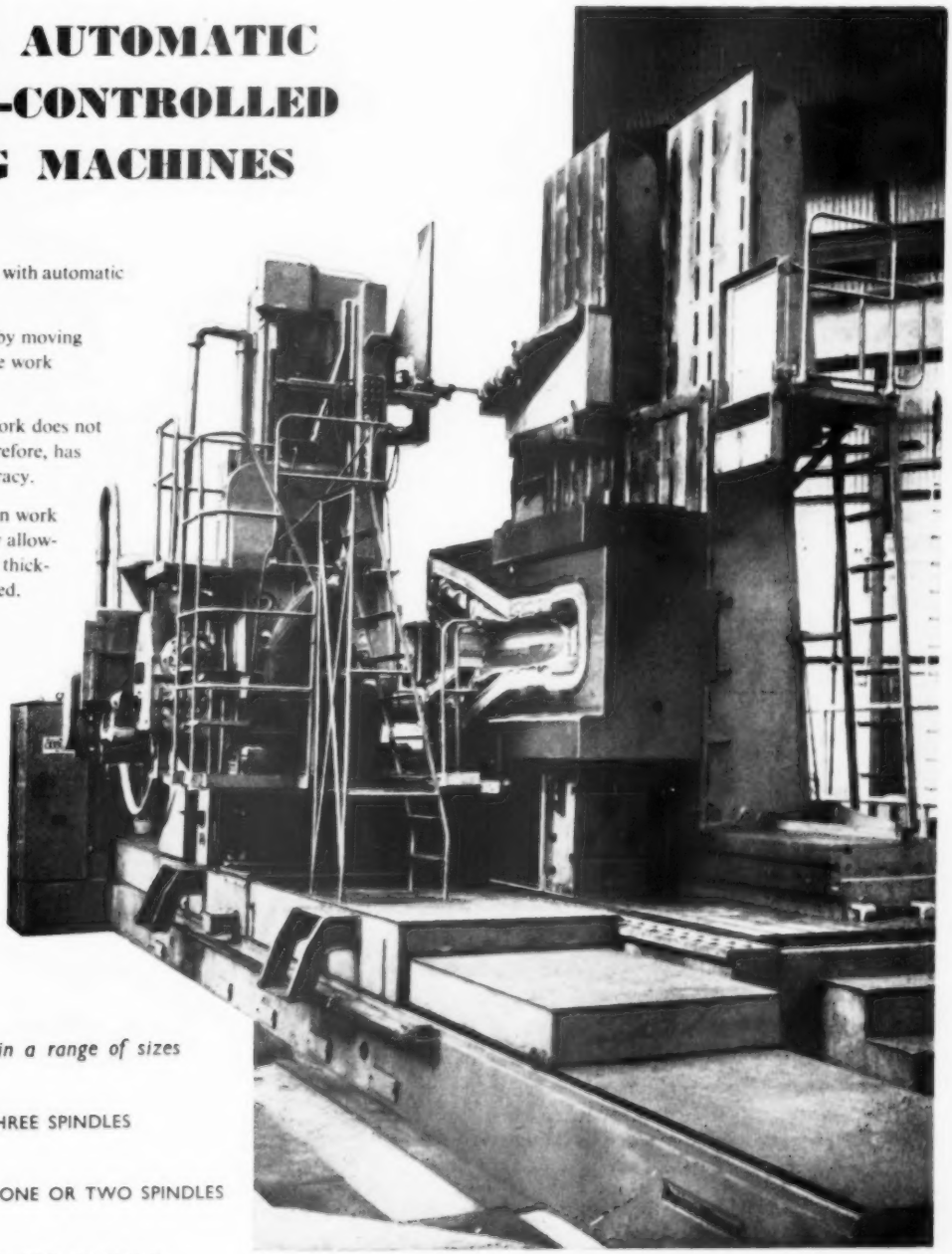

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AD. 353

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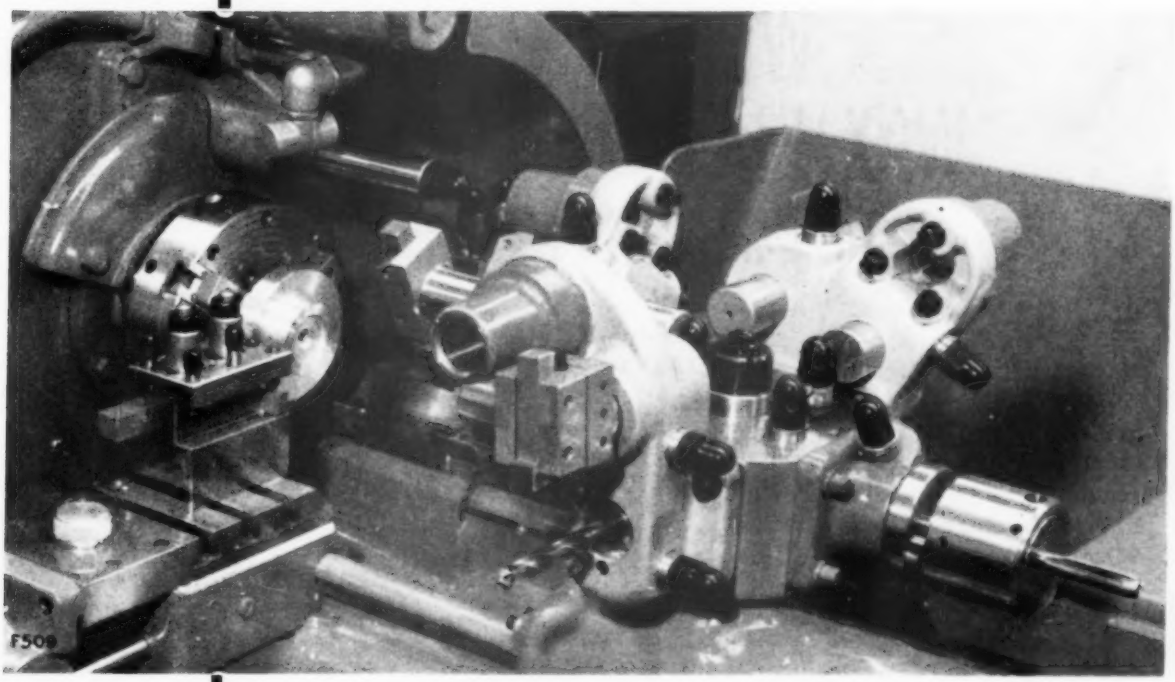

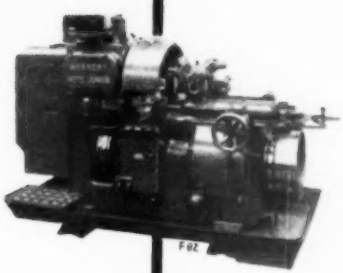

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Twenty eight reversible speeds from 35 to 1484 or 53 to 2200 r.p.m.

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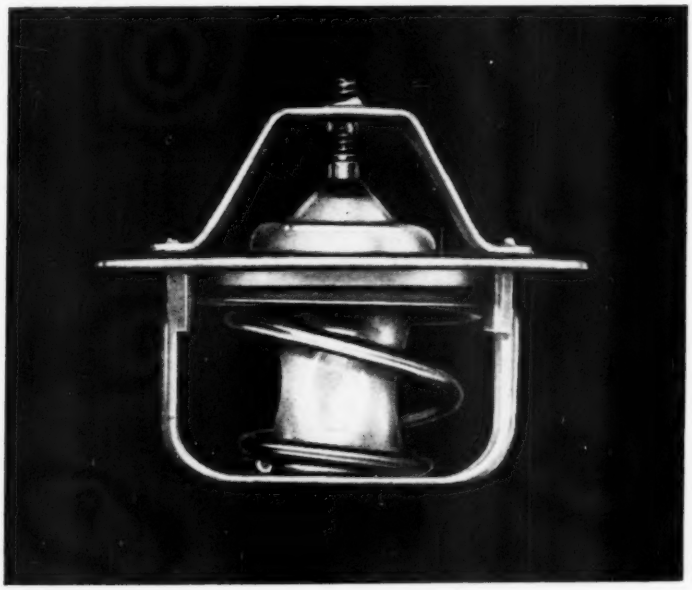

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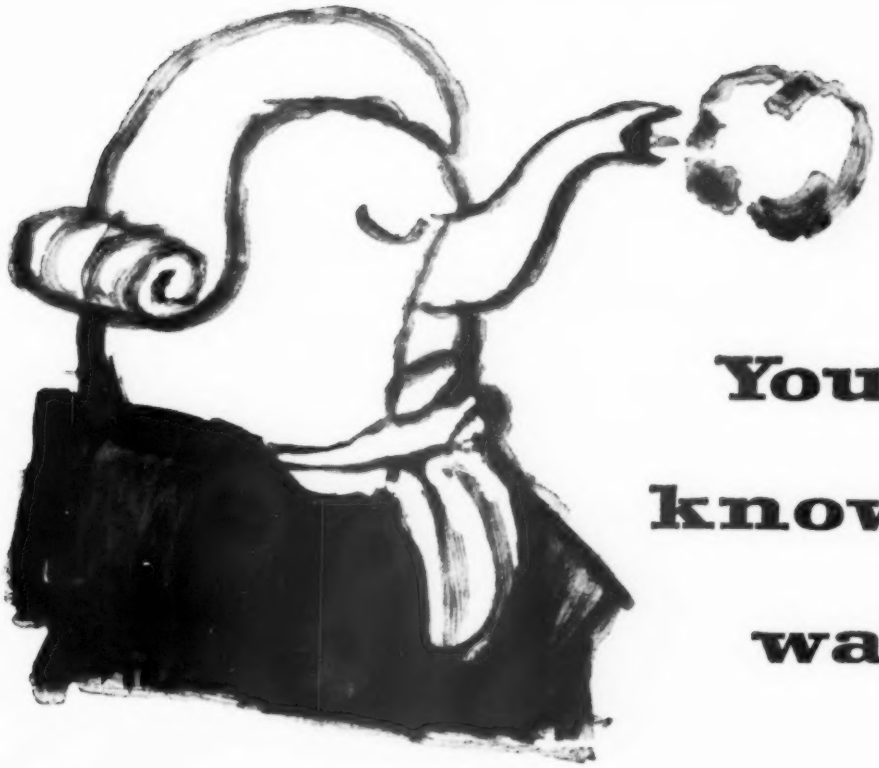

You know watt?

Which Wat? Watt! *What?* Watt . . . Snap! You know milliwatt? *Millie . . .?* Watt! Ever meter? . . . (Such levity. Deplorable. Fresh start.)

You make, you test, you check, you measure . . . what? Distance? permittivity? salinity? impedance? wattage? Through long days, summer winter, you are making, testing, measuring, coping. But . . .

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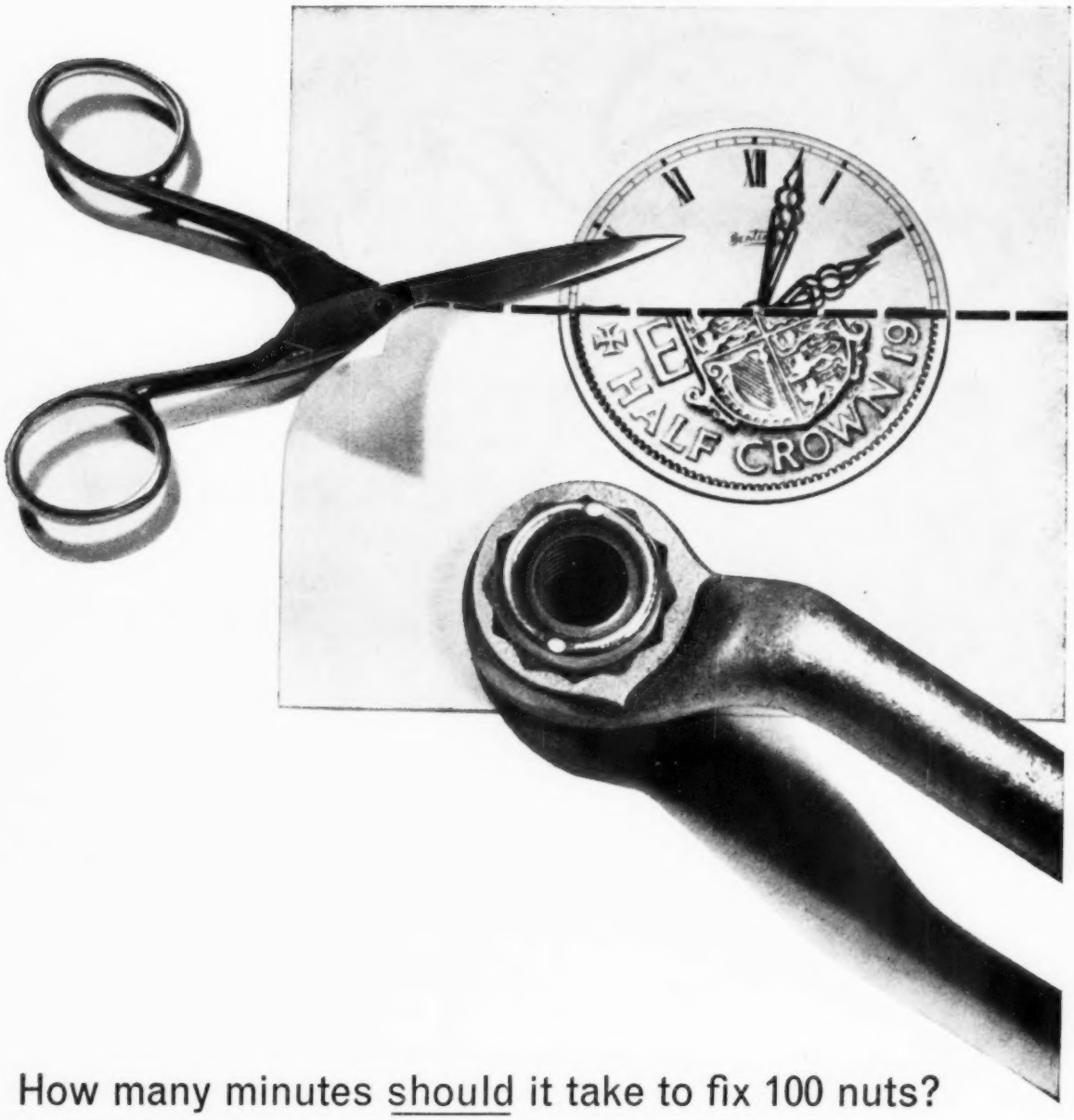

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* There are also technical and other advantages so why not call in Simmonds to carry out a completely thorough costing of your present assembly methods?

** All times shown are based on "The Handbook of Standard Time Data for Machine Shops" by Haddon & Genger, published by Thames & Hudson Limited, London.*

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CRC 42N

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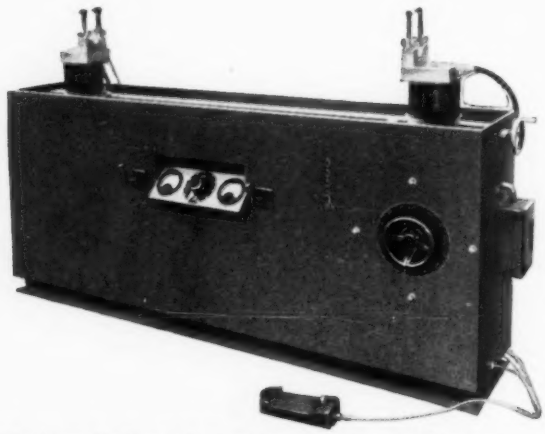

The Metroflux Type "SA" universal magnetic crack detector is an extremely flexible unit. It is of great value for testing components of large size or awkward shape, and for routine testing of mass-produced components.

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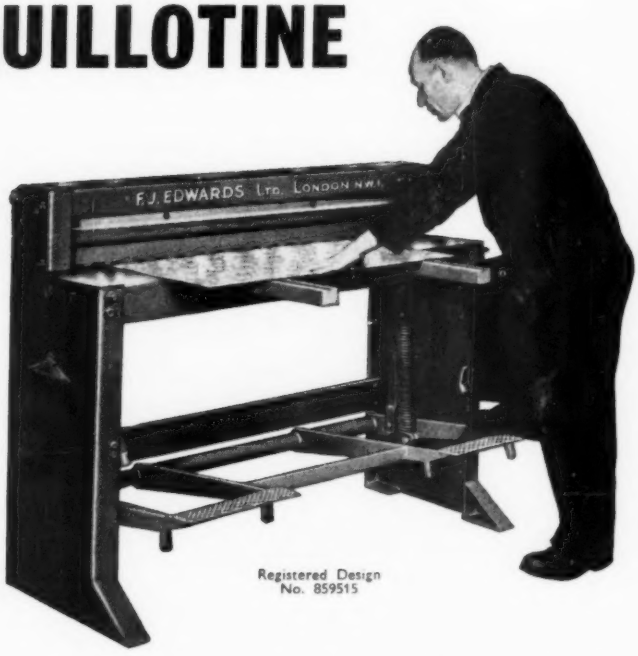

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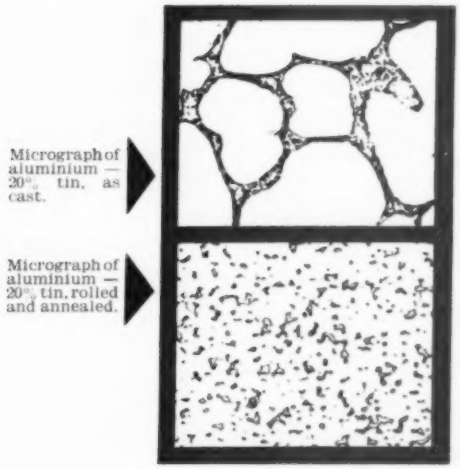

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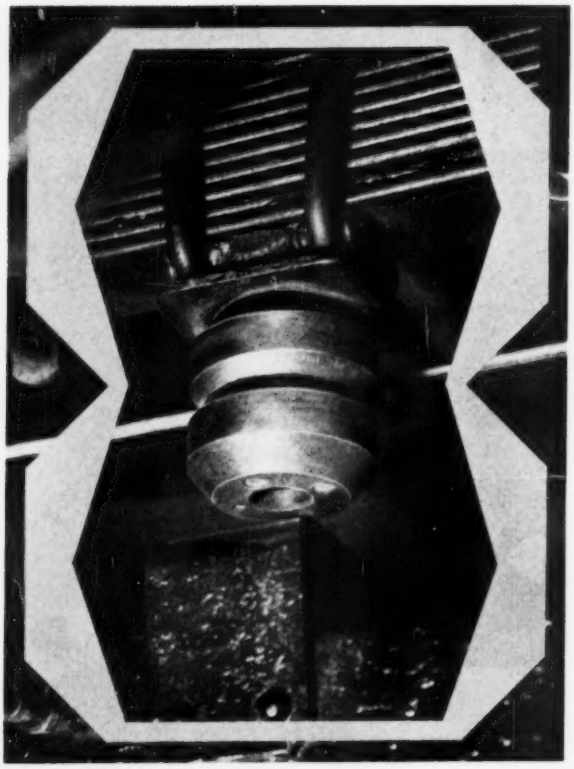

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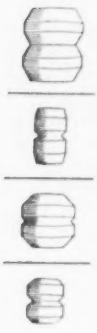

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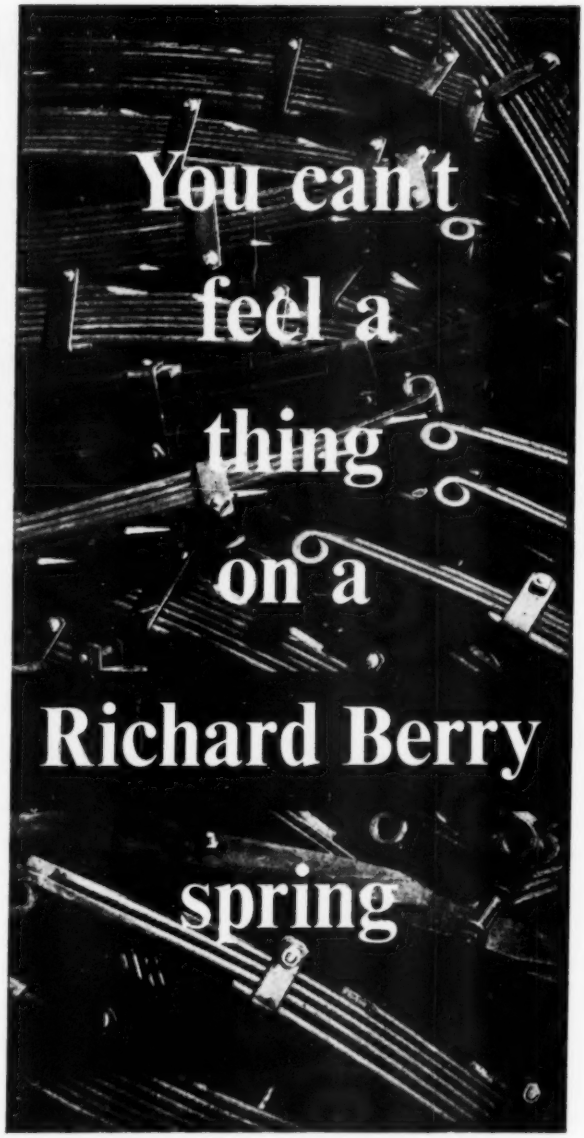

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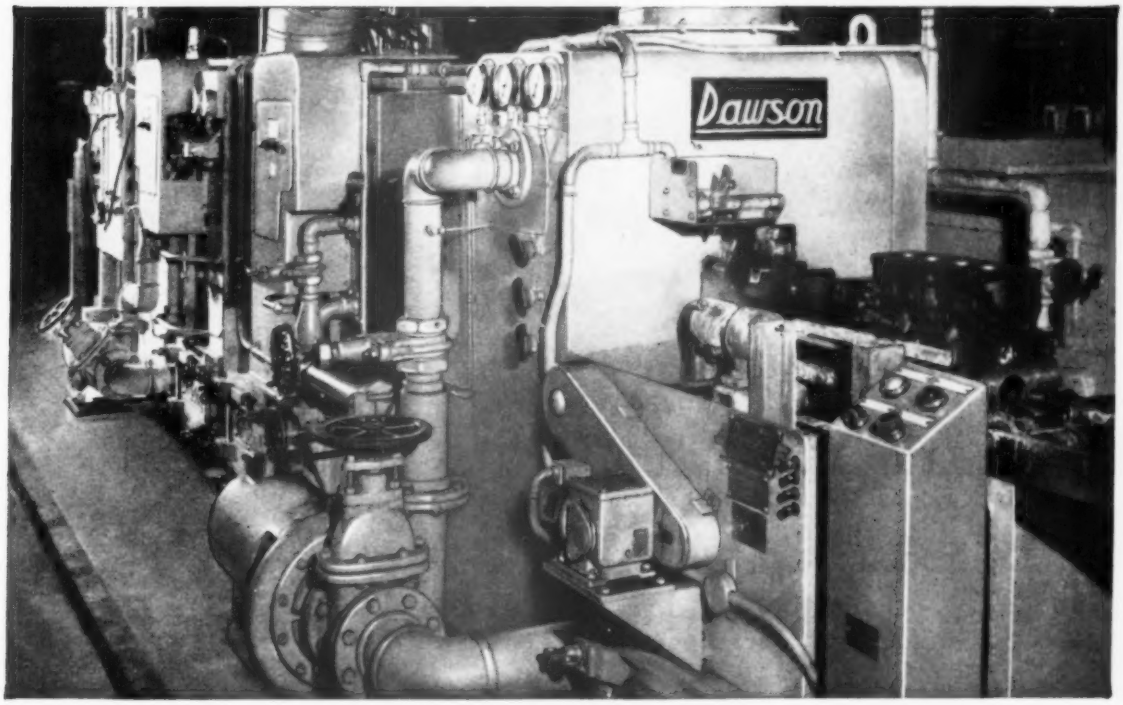
Dawson Automatic cylinder block Washer for the new AUSTIN se7en



The fully automatic Dawson machine illustrated is used to remove all cast iron swarf and cutting oils from the Austin Seven cylinder blocks before engine assembly. It is continuous in operation and handles up to 80 blocks per hour. The blocks are carried through the machine intermittently, pausing at each cleaning station in accordance with a controlled time cycle. An important feature of the machine are the swing type hydraulically operated jetting boxes (patent applied for) incorporated in the washing sections. Each of these has a main nozzle which is spring pressed on the main oil bore gallery at each end of the cylinder block, making a liquid tight connection. Thus the gallery is positively flushed from both ends, the liquid passing through all subsidiary ducts before escaping from the block. In addition, these jet boxes have secondary nozzles accurately registered with all the bores and recesses at the ends of the cylinder blocks.

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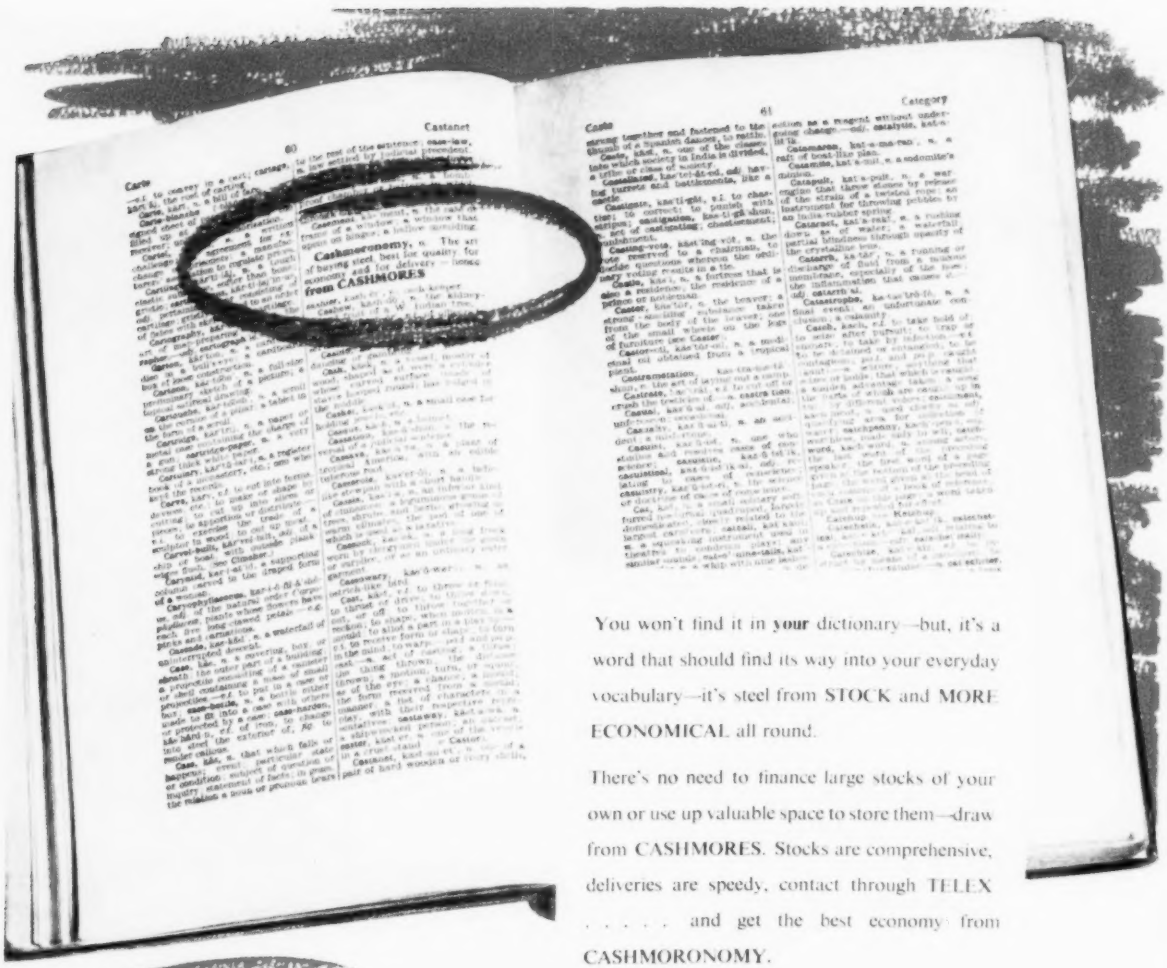

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